-M/045/017

BARRICK
MERCUR

BARRICK RESOURCES (USA) INC.
Barrick Mercur Gold Mine
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December 30, 1997

Mr. Don A. Ostler, PE, Director
Division of Water Quality
Utah Department of Environmental Quality
288 North 1460 West
P.O. Box 144870
Salt Lake City, UT 84116

Dear Mr. Ostler:

Re: UGW450001

Attached please find the final proposed closure plan and request for construction permit for the Valley Fill Leach Area 3 (VFL3) facility located at the Mercur Mine. The document entitled ***Appendix B to Permit No. UGW450001, Barrick Resources (USA) Inc, Mercur Mine Valley Fill Leach Area 3, Groundwater Quality Discharge Permit UGW450001 Final Closure Plan, December 1997***, was prepared with the assistance of John Brown at Global Environmental Technologies.

As you are aware, active gold production ceased and detoxification initiated for this facility in 1997. The closure plan submitted herewith identifies the processes, practices, and procedures to be utilized by Barrick to complete the reclamation, revegetation, and post-closure monitoring of VFL3. Please note that while the schedules for completion of this final closure are not exact, Barrick is proposing to complete all practicable activities in 1998.

To facilitate this goal, Barrick requests a meeting with the Division staff responsible for review and approval of this plan by the end of January 1998. Initiation of discussions at this early date will allow final details to be determined and approvals received prior to May 1, 1997, the target date for initiation of final reclamation. Barrick is committed to provide all necessary staff and resources to assist the Division in the plan approval process.

Please contact Dave Beatty at 801-268-4447x335, or me to arrange for the above noted meeting.

Respectfully;

Glenn M. Eurick
Director Environmental Relations US

C: attachments — D.P. Beatty, B.W. Buck (JBR), M.A. Wright (UDOGM)
C: w/o attachments — C.L. Landa, C.L. Olsen, J.S. Brown (GET), D. Frederick (UDWQ)

APPENDIX B TO PERMIT UGW450001
BARRICK RESOURCES (USA) Inc.
MERCUR MINE VALLEY FILL LEACH AREA 3
GROUND WATER QUALITY DISCHARGE
PERMIT UGW450001
FINAL CLOSURE PLAN

Original: October 28, 1991
Revision 1: January 13, 1995
Revision 2: January 1996
Revision 3: August 1996
Final Proposed: December 1997

GLOBAL ENVIRONMENTAL TECHNOLOGIES L.L.C.
3630 EAST CASCADE WAY S.L.C. UTAH 84109 801·463·0902 801·463·0504 FAX

December 23, 1997

Mr. Glenn Eurick
Barrick Resources (USA), Inc.
8 East Broadway
Suite 613
Salt Lake City, UT 84111

RE: Transmittal of Barrick Resources (USA), Inc. Mercur Mine Valley Fill Leach Area 3 Ground Water Quality Discharge Permit UGW450001 Final Closure Plan

Dear Glenn:

Please find enclosed 5 copies of the final closure plan for Valley Fill Leach Area #3 (VFL3). This document includes descriptions and timing of activities planned for the final closure of VFL3, results of the bioremediation activities performed by Compliance Technology, and the results of the dewatering well installation. We have provided you with the additional copies necessary for your distribution to the Utah Division of Water Quality, Utah Division of Oil, Gas, and Mining, and the Mercur Mine.

We appreciate the opportunity to work with you on this project. Please contact me if you have any questions regarding this transmittal.

Very truly yours,
Global Environmental Technologies, L.L.C.

John S. Brown, P.G.
Manager

Enclosure: 5 Reports

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Attachments: (2)

Appendix A - Cyanide Bioremediation of Barrick Mercur's VFL#3 Heap Leach Pad

Appendix B - Dewatering Well Installation, Valley Fill Leach Area #3, Barrick Mercur Gold Mine

1.0 GENERAL

A construction permit for Valley Fill Leach Area No.3 (VFL3) was issued on July 13, 1990, by the Utah Department of Environmental Quality, Division of Water Quality (UDWQ). Conditional Groundwater Quality Discharge Permit No. UGW450001 was issued on July 10, 1990, with an expiration date of July 10, 1995. The conditional Approval to Operate the facility was issued in December 1991. The facility has continued to operate with the approval of the UDWQ.

The formal renewal process for UGW450001 was accelerated from January 1995 to August 1994 to expedite necessary changes in ground water quality protection levels and operating conditions for VFL3. A renewed Ground water Quality Discharge Permit No. UGW450001, with conditions, was issued December 12, 1994, and expires December 12, 1999.

The following conditions are specified in Part I.H.1-3 of the renewed permit:

- Necessary revisions to the Quality Assurance/Quality Control Plan (QA/QC) as required by Part E.5.a of the renewed permit were submitted as Appendix A by January 13, 1995.

- Necessary revisions to the Conceptual Closure Plan as required by Part I.D.8 and I.H.2 were submitted as Appendix C by January 13, 1995. This revised Conceptual Closure Plan contained the following information:

    (1) Discussion of spent ore neutralization techniques
    (2) Discussion of final site contouring, drainage, and cover design
    (3) Discussion of post-closure ground water monitoring program
    (4) Discussion of post-closure facility monitoring

- Submittal of a final VFL3 Closure Plan, pursuant to Part I.H.3 of the permit, was required no later than 90 days prior to the closure date of the facility. The original closure date for VFL3 was expected to be December 1997. Exhaustion of ore earlier than modeling predicted necessitated Barrick to call for cessation of leaching in mid-1997. Submittal of final proposed closure plans were strategically delayed until December 1997 to await results of the bioremediation activities for VFL3 and the installation of the dewatering well.

The UDWQ reviewed the January 13, 1995, revised conceptual plan and raised additional issues in correspondence dated October 6, 1995. Barrick responded to these

additional concerns by incorporating changes into Revision 2 and submitting the plan on January 8, 1996.

On April 19, 1996, Barrick Mercur Mine management met with the UDWQ to discuss revisions to the conceptual closure plan. The UDWQ requested that Barrick perform column rinse studies to evaluate rinsing options for VFL3. As a result of the meeting, Barrick agreed with the UDWQ to perform column rinse studies. The results of these studies were presented in the August 1996 Conceptual Closure Plan (Revision 3) as Attachment 2 to that document. The August 1996 Conceptual Closure Plan was approved by the UDWQ on May 23, 1997.

On June 4, 1997, Barrick Mercur Mine management met with the UDWQ to discuss the operating plan for the detoxification of VFL3 using bioremediation techniques. Results of the bioremediation activities are documented in "Cyanide Bioremediation of Barrick Mercur's VFL#3 Heap Leach Pad" contained in Appendix A to this closure plan.

During the June 4 meeting, Barrick also discussed the submission of a plan for installation of a vertical dewatering well in VFL3 to remove residual saturation from the sub ore during closure activities. The dewatering well plan and technical specifications were submitted to the UDWQ on June 15, 1997 and approved by the UDWQ in July 1997. The well was drilled and completed between the dates of October 20 through October 28, 1997. Details of the construction of the well are contained in "Dewatering Well Installation, Valley Fill Leach Area #3, Barrick Mercur Gold Mine", Appendix B to this closure document.

It should be noted that the closure plan for VFL3 is only one component of the overall Mercur Mine Comprehensive Final Closure Plan. The development and implementation of the Mercur Final Closure Plan is a dynamic activity and may necessarily require minor modifications in any ultimate VFL3 closure plan scenario. The Mercur Closure Plan will be developed pursuant to the cessation of ore mining activities in March 1997 and milling activities in March 1998 and submitted to the Utah Division of Oil, Gas, and Mining as well as to the UDWQ for their respective jurisdictional approvals.

2.0 FACILITY DESCRIPTION

VFL3 has been utilized for the cyanide leaching of subore from the Mercur Mine since December 1990. Ore loading ceased in February 1997. The facility operated until October 1, 1997 for gold recovery. Gold recovery continued through bioremediation between the dates of June 16 through October 1, 1997. VFL3 is now undergoing complete facility closure. Section 3.0 describes the closure procedures implemented and planned as of this date for the closure and post-closure physical and ground water quality monitoring of VFL3.

3.0 CLOSURE PROCEDURES

3.1 Neutralization

Following optimum resource recovery from VFL3, the application of cyanide solution for gold leaching was discontinued in June 1997. Cyanide and reagent storage, support systems, and all non-essential elements of the VFL3 plant were converted for bioremediation purposes, and then dismantled. Carbon tanks were used to polish rinse solutions with activated carbon. Pumping, piping, and all essential elements of the existing plant necessary to carry out the neutralization and closure program were utilized during bioremediation activities, which were carried out between the dates of June 16 through October 1, 1997. Solution application systems used for cyanide application were converted for the use of neutralization solution and bioremediation application.

VFL3 was neutralized in 1997 for cyanide-WAD and pH using the following methodologies:

- An initial neutralization using recycled VFL3 barren solution without cyanide fortification in order to reduce the cyanide-WAD levels;
- Incidental rinsing with natural precipitation to provide additional make up water to the system;
- Bioremediation treatment through inoculation of recycled barren solution.

The goal of the 1997 neutralization effort was to achieve rinsate solution characteristics that will, under long-term infiltration conditions, be protective of the ground water regime underlying VFL3. Bioremediation treatment using inoculation of indigenous bacteria was accepted in the August 1996 Conceptual Closure Plan as the preferred method of treatment. Bioremediation was initially evaluated through column rinse test studies (Attachment to the August 1996 Revised Conceptual Closure Plan). Both the column rinse test results using process waters from VFL3, and the bioremediation effort during 1997 at VFL3 indicated that this method of rinsing provided a relatively rapid decline in cyanide-WAD concentrations while minimizing the addition of water to the system. Incidental but welcomed reductions in the levels of arsenic, mercury, copper, and nickel were also achieved. Results of rinsing VFL3 during 1997 with the addition of bacteria are contained in Appendix A to this document.

Experience obtained in the neutralization of previously closed Valley Fill Leach Areas 1 (VFL1) and 2 (VFL2) was also drawn upon during the VFL3 neutralization effort. VFL1 experienced limited fresh water application followed by an extended period of natural precipitation infiltration prior to capping. VFL2 was rinsed with tailings reclaim solution, fresh water, natural precipitation, and reclaim solution treated with ferric sulfate. The final closure plan for VFL2 was approved in May 1995 and is currently being implemented.

Barrick does not anticipate additional designed rinsing of the VFL3 sub ore beyond the 1997 rinsing performed during the bioremediation of the heap. Any additional applied fresh water, other than from unavoidable incidental precipitation and/or snowmelt, may increase the level of environmental impact associated with water balance considerations during the closure of the tailing impoundment. Samples taken from the newly installed dewatering well at VFL3 indicate that the bioremediation has achieved the targeted neutralization goals for cyanide-WAD and pH.

The schedule of events for VFL3 neutralization include:

- May 1997: Cyanide solution application for gold leaching was discontinued. All solutions were managed at the VFL3 plant and recirculated within VFL3. Rinsing of VFL3 spent ore was accomplished using barren recycle solution for additional incremental gold recovery and physical displacement of residual free and WAD cyanide.

- Bioremediation treatment was initiated through inoculation of the recycled barren solution being applied to the heap between the dates of June 16 through October 1, 1997.

- A 6-inch vertical dewatering well was completed to 174.5 feet below grade in the deepest portion of the cistern basin. The well was completed and tested on October 27, 1997. The well will be pumped to minimize fluid head on the liner during closure and reclamation. The vertical well will be used to pump water to within several feet of the liner to assist in dewatering with the existing VFL3 process pump. All waters will be pumped to the tailing impoundment. The schedule for this activity is subject to water balance considerations within the tailing impoundment and may incorporate pumping "'rest–periods".

- November 1997-1998: Natural precipitation will intermittently infiltrate the VFL3 neutralized ore and be managed pursuant to the tailing impoundment water balance. The anticipated quantities of this additional source of water will be in the

millions of gallons and will assist in depleting the neutralized ore of contaminants of concern. No application of pumped potable water will be used. Head levels within the cistern basin will be pumped using the vertical dewatering well to maintain a minimal fluid level on the liner system, as presented in the Infiltration and Solute Transport Analysis, provided as an attachment to the August 1996 Conceptual Closure Plan. Use of the vertical dewatering well will allow for decommissioning of the cistern production pumping system. All pumping to the tailing impoundment is scheduled to cease by 2001 with the final closure actions of the tailing impoundment.

- 1998: Complete design infiltration and plume transport modeling efforts, and initiate physical closure activities. Physical closure activities are scheduled to initiate at the beginning of the construction season in 1998, and will include:

  1. Grouting of both the upper the lower leakage collection system pipes and removal of the LCS tankage. Grouting of the leakage collection system is proposed because the upper leakage collection system discharges at a deminimus average rate of 26 gallons per month while the lower leakage collection system remains dry.

  2. Subsoil cover placement on the sub ore.

  3. Topsoil placement and seeding.

  4. Dismantling and removal of reagent storage, support systems, and all non-essential elements of the VFL3 plant.

Solution characteristics will be monitored pursuant to the applicable VFL3 Ground Water Quality Discharge Permit UGW450001 and associated Quality Assurance/Quality Control Plan.

Barrick considers neutralization of VFL3 complete at this time as rinsate quality has achieved modeled parameter characteristics.

3.2 Dewatering

The removal of solutions from VFL3 will be managed for a period of four years from the final date of dewatering well installation or October 2001. Barrick anticipates decommissioning of the existing production cistern as water levels in VFL3 diminish. Neutralization solution pumped from VFL3 will be taken to the tailing impoundment East Bay for forced evaporation. At the end of the four-year VFL3 solution management period, all pumping activity will cease. At this time, results of infiltration modeling

indicate that the long-term levels of residual fluids and meteoric infiltration impounding on the liner system will be less than the operating head levels in VFL3.

3.3 Facility Decommissioning

Upon completion of the dewatering and approval from the UDWQ that the neutralization effort has achieved acceptable rinsate characteristics, all distribution piping will be decommissioned. Both the upper and lower leakage collection systems will be grouted closed and associated tankage removed. The operating pregnant solution pumping system will be decommissioned in favor of the vertical dewatering well. The dewatering well will remain intact for a period of four years from the installation date to accommodate fluid management considerations discussed in the Infiltration and Solute Transport Analysis, provided as an attachment to the August 1996 Conceptual Closure Plan. Upon completion of all spent ore dewatering activities no later than October 2001, the plant site, cistern, dewatering well, and all associated components will be dismantled and disposed of or salvaged in accordance with applicable law. Power supply components, ground water wells, area lighting, and associated devices will remain to accommodate the post-closure ground water monitoring period.

3.4 Shaping / Contouring

VFL3 was loaded at a 3:1 horizontal:vertical configuration to accommodate final shaping. Drawing Valley Fill Leach Area 3, 3:1 Contour, December 16, 1994, which was provided with the August 1996 Conceptual Closure Plan, depicts this configuration.

Following the decommissioning of the solution distribution piping, the spent ore will be contoured and shaped to a configuration and bearing capacity sufficient to support a final cover. Approximately 28 acres will be involved at an overall side slope of 3:1.

The two upgradient drainages have been filled with mine overburden material to an elevation consistent with the two roadways passing around the VFL3 site on the west and east sides. The tops of these filled areas will be topsoiled and the drainages routed to tie into the above-mentioned channels.

3.5 Cover Placement

The final cover is anticipated to consist of two distinct zones: (1) a nominal three foot layer of subsoil, and (2) a nominal one foot layer of topsoil and demonstrates application of Best Available Technology. Justification for this conceptual cover design is provided in the report entitled "Infiltration and Solute Transport Analysis, August 1996, TriTechnics Corporation for Barrick Mercur Mine" which was provided with the accepted August 1996 Conceptual Closure Plan. The cistern and vertical dewatering well pumping systems will be removed and cover installation completed in these limited areas only after the decision is made by UDWQ/Barrick that additional pumping of residual heap solutions is not warranted as a result of cover effectiveness. This date is anticipated to be October 2001.

3.6 Erosion Control / Revegetation

The final topsoil cover will be graded to prevent significant ponding of water. Additionally, Best Management Practices to mitigate erosion potential will be practiced. Concurrent with the erosion control placement, the topsoil will be seeded by hydroseeding or other methods approved by the Utah Division of Oil, Gas & Mining. It is anticipated that a seed mixture of native grasses, legumes and shallow-root brushes will be utilized at VFL3. All seed mixture will be applied with appropriate mulch and fertilizer.

3.7 Post-Closure Facility Monitoring

Post-closure monitoring will ultimately be designed to satisfy the various regulatory agencies with applicable oversight. Monitoring of the revegetative effort will continue while ground water post-closure monitoring is being performed. The goal of the revegetation is to achieve adequate plant growth that is self-propagating within a period of 3 growing seasons, in accordance with the Utah Department of Natural Resources, Division of Oil, Gas & Mining surety bond release provisions. Monitoring of facility stability and erosional impacts, and general security matters will be maintained until Barrick has accomplished all site responsibilities. Monitoring of the final cover will consist of quarterly inspections during the revegetation period for cover erosion, settlement, animal burrows, drainage ditch conditions, and plant growth. Immediate repairs will be undertaken as necessary to return the spent ore cover to the original

post-closure conditions. The date for completion of all VFL3 reclamation activities is currently projected at 2001, including the immediate areas around the cistern and dewatering well.

Access to the reclaimed VFL3 may remain open indefinitely utilizing the historical public access road to the east side of the site up Meadow Canyon, as mandated by Barrick's conditional use permit with Tooele County and agreements with adjacent landowners. Alternate routing away from VFL3 will be evaluated as well as protective barriers for VFL3 access.

4.0 POST-CLOSURE FACILITY GROUND WATER QUALITY MONITORING

Valley Fill Leach Area 3 Ground water Quality Discharge Permit UGW450001 expires in December 1999. The projected date for initiation of VFL3 physical closure activities to commence is at the start of the construction season in 1998. Therefore, a renewal application for UGW450001 is currently scheduled for submission to the UDWQ in June 1999 for continued ground water quality monitoring of the facility during the period between December 1999, and December 2002. This schedule may be adjusted if a consensus decision is made to renew UGW450001 upon cessation of active leaching.

Ground water monitoring during the post-operational phase of VFL3 will be governed by applicable permit conditions. The necessity for ground water quality monitoring beyond the year 2002, which would require yet an additional permit renewal, will be determined by June 2002.

APENDIX A TO FINAL CLOSURE PLAN
GROUND WATER QUALITY DISCHARGE PERMIT
UGW450001

CYANIDE BIOREMEDIATION OF BARRICK MERCUR'S
VFL#3 HEAP LEACH PAD

Compliance Technology

Innovative Systems for the Remediation of Mine and Industrial Process Waters

Cyanide Bioremediation of Barrick Mercur's VFL #3 Heap Leach Pad

November 4, 1997

2726 S. 2700 W., Salt Lake City, UT 84119, Ph. (801) 974-5386, Fax (801) 974-5398

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Executive Summary

Active cyanide detoxification was pursued at Barrick Resources (USA) Inc., Mercur Mine Valley Fill Leach #3, (VFL #3) heap leach pad to ensure that low levels of residual WAD cyanide could be achieved. Testing of several detoxification methods showed that bioremediation was capable of increasing the rate of cyanide destruction for a relatively low cost.

A bioreactor was constructed at the VFL #3 process area. The purpose of the bioreactor was to grow large numbers of cyanide-degrading bacteria in a short period of time. Laboratory testing had shown that the VFL #3 process solution contained indigenous cyanide-degrading bacteria and that these bacteria populations could be increased to high numbers (10^8 cells/mL) using brewers yeast extract as the bacterial nutrient.

The bioreactor consisted of a 4000-gallon, stirred tank to which VFL #3 process solution and nutrient were added on a continuous basis. The bioreactor was heated using an immersion heater and air was bubbled into the tank to maintain aerobic conditions. The bioreactor produced a high bacteria inoculum that flowed into the barren surge tank. Solution flow through the bioreactor was initiated June 16, 1997. The bioreactor was operated until October 1, 1997.

Within a month after initiation of bacteria addition, the WAD cyanide concentration in the VFL #3 pregnant solution decreased from about 29 mg/L to less than 0.56 mg/L. Much of this initial decrease was natural degradation of free cyanide. By October 1, 1997, the entire surface of VFL #3 had been sprayed with bacteria inoculum. The resultant rinsate from all parts of the pad contained between 0.20 and 0.56 mg/L WAD cyanide; the target WAD cyanide concentration of 0.20 mg/L was achieved on a sporadic basis through the inoculum period.

The concentrations of metals present as WAD cyanide complexes also decreased, indicating that the bacteria were indeed destroying the WAD cyanide. The copper concentration in the pregnant solution dropped from 0.97 to 0.018 mg/L, while mercury concentrations decreased from 1.3 to 0.002 mg/L. Nickel, which forms a particularly strong WAD cyanide complex, dropped from 1.3 to 0.02 mg/L. Since arsenic in the VFL #3 process solution is not present as a cyanide complex, cyanide bioremediation did not have a significant effect on the arsenic concentration.

Introduction

Options for cyanide detoxification of Barrick Mercur's 5-million ton Valley Fill Leach #3 (VFL #3) heap leach pad were evaluated in May of 1996. Column rinse tests were performed at this time to compare five rinsing/detoxification techniques. These techniques included barren solution recycle, fresh water rinsing, hydrogen peroxide treatment, ferrous sulfate treatment and bioremediation. Although fresh water rinsing provided the fastest detox, this technique would generate a large amount of rinsate requiring handling problems at the tailing impoundment. Of the other methods tested, bioremediation provided the quickest reduction in cyanide and was chosen as the method for detoxification of the VFL #3 heap. These column rinse test results were summarized in a report to Barrick Mercur dated July 22, 1996.

Bioremediation involves growth and application of cyanide-degrading bacteria (*Pseudomonas pseudoalcaligenes*) to the heap leach pad. These bacteria metabolize the cyanide, utilizing the nitrogen to form amino acids, while the carbon is either taken into the bacteria cellular structure or released as carbon dioxide. Consequently, byproducts from cyanide bioremediation are nontoxic.

A lab-scale continuous bioreactor was operated to determine full-scale operating conditions and best nutrient. This testing indicated that a 2400-gallon bioreactor with a continuous flow of 3.3 gpm would result in a bacteria population of 10^6 cell/mL in the barren solution flow to the pad. The nutrient which provided the best growth of bacteria was Amberex 1003AG, an agglomerated brewers yeast extract.

Conversion of the Cyanide Tank to a Bioreactor

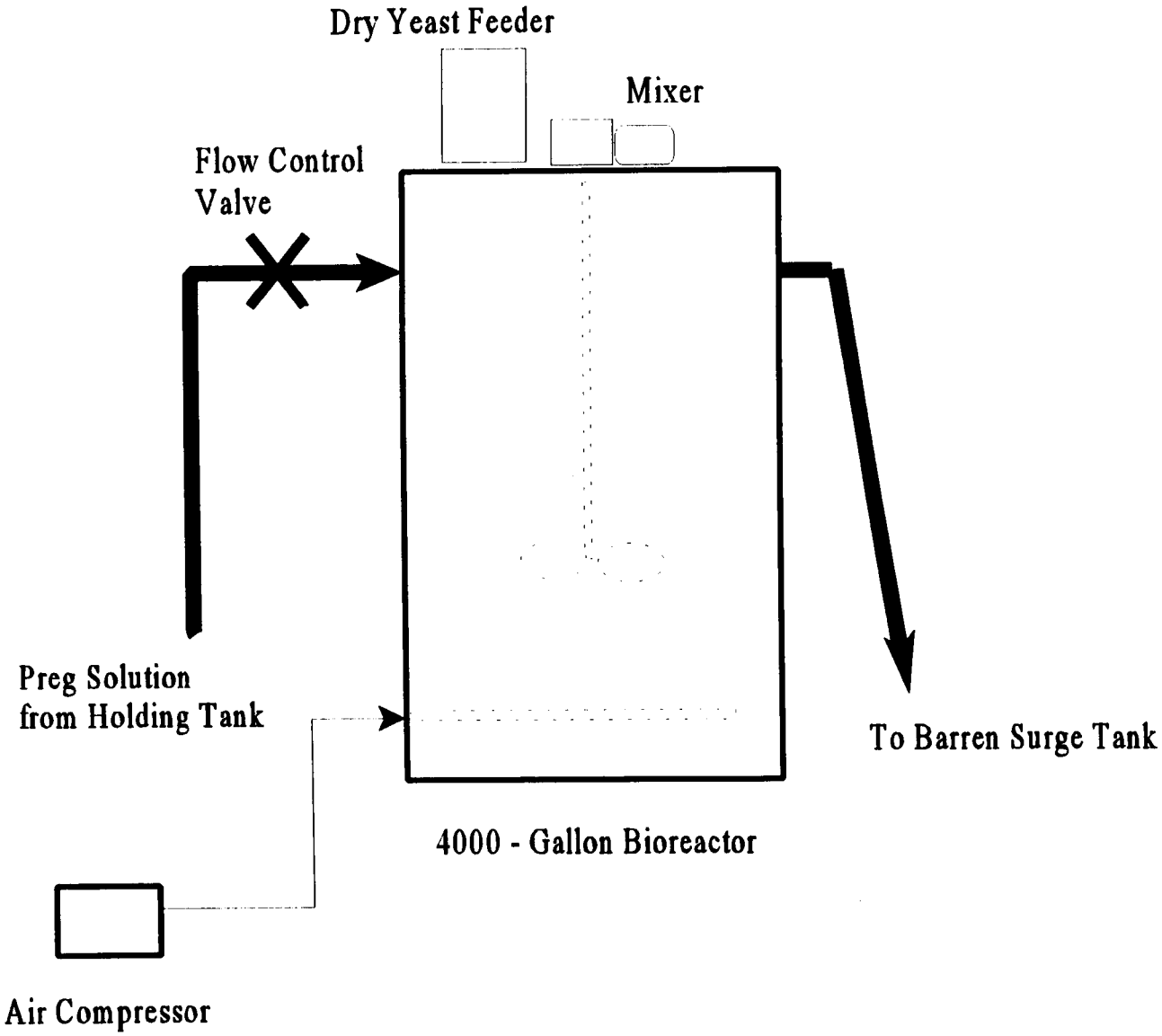
Cyanide bioremediation was performed at the VFL #3 heap leach pad by growing cyanide degrading bacteria to a high population in a continuous flow-through bioreactor and adding these bacteria to the barren solution sprayed on the pad. A 4000-gallon tank capable of achieving the designed flowrate and population of bacteria was converted to a bioreactor. The bioreactor was configured according to Figure 1. The following modifications were made to the tank:

- The original cyanide mix tank was used to feed the bioreactor because a pump and flowmeter already existed at the discharge of this tank which could control flow to the bioreactor in the range of 0 to 5 gpm. In addition, the mix tank contained a heater which could preheat the barren solution.

- The mixer, which had one impeller mounted on a 4-ft shaft, was overhauled to handle continuous service.

- A small vane-type air compressor, capable of delivering 9 cfm air, was mounted to the side of the tank to provide air for the aerobic bacteria. The air was fed to the reactor via a 1-inch pipe mounted horizontally across the tank below the mixer. Small holes were drilled

Figure 1. Full-scale bioreactor.



into the pipe immediately below the mixer.

- The outlet of the bioreactor was piped to allow the tank to maintain a full level at all times. Thus, the tank was operated by solution overflow. The outlet drained directly to the carbon column discharge surge tank.

- A dry-powder screw feeder (Accu-rate) was installed on top of the mix tank to feed the Amberex 1003AG. The discharge of the feeder was enclosed to prevent wind loss of the nutrient.

- Thermostatically-controlled immersion heaters were used in both the bioreactor and the holding tank to maintain a temperature of about 70°F (heating the pad runoff from 45 to 70°F significantly increases the growth rate of the bacteria).

Initiation of Bacteria Growth

The growth of bacteria in the bioreactor was initiated the week of June 9, 1997 by filling the bioreactor with barren solution. One forty pound bag of Amberex 1003AG was added to the reactor. The mixer was turned on and air flow to the reactor was initiated. Indigenous bacteria in the barren solution began to multiply. By June 16, 1997 the bacteria population in the bioreactor had increased to 5.6×10^8 cells/mL. No barren solution or nutrient was added during this growth period. Bacteria populations were measured with a microscope using a Petroff-Hauser counting chamber.

Continuous-Flow Operation

On June 16, 1997, solution flow through the bioreactor was begun, thus, initiating the bacteria inoculation into the barren surge tank; the bacteria-laden barren solution was then sprayed onto the pad. Amberex 1003AG was continuously fed to the reactor with the screw feeder. The bioreactor was operated from June 16, 1997 until October 1, 1997 with intermittent shut-downs. The shut-downs were caused by power outages; problems with the air compressor and the mixer also caused shutdowns. Some of the interruptions required that the bacteria population be allowed to increase before restarting flow-through operation.

The bioreactor was monitored for pH, dissolved oxygen, temperature, solution flow and nutrient feeder setting (Table 1). A bacteria population of 10^7 to 10^9 cells/mL was maintained in the bioreactor during flow-through operation. Bioreactor temperature was maintained at 64 to 78°F. During flow-through operation, the dissolved oxygen concentration remained below 1 mg/L which is an indication of significant biological oxygen consumption. An unsuccessful attempt was made to increase the oxygen concentration in the bioreactor by adding baffles to increase mixing efficiency. The bacteria produced in the bioreactor during continuous operation were aerobes even though the dissolved oxygen concentrations were low. Conditions in the bioreactor may have become anaerobic on two occasions when solution flow through the tank was disrupted. A

Table 1. Operating log of VF-3 bioreactor

Date	Temperature, Fahrenheit	Flow, gpm	Bacteria, cells/mL	Dissolved oxygen, mg/L	pH	Feeder setting, %	Comments
06/16/97	78	2.0	5.6E+08	0.34		5	Start flowthrough
06/19/97	75	2.0	1.1E+08	2.52		5	
06/25/97	75	2.0	1.0E+09	0.15	7.24	5	
06/26/97	75	2.0	9.4E+08	0.88	7.21	4	
06/30/97	77			0.50			
07/05/97	55	0.0					Refill tank
07/08/97	75	0.0		0.28	7.50	0	Add full bag yeast
07/09/97	75	4.0	8.0E+07	7.15	7.98	4	Start flowthrough
07/10/97	72	4.0	1.6E+08	0.28			
07/14/97	75	4.0		3.78	7.52	4	
07/16/97	78		1.2E+08	0.38			
07/31/97	75	3.0	2.0E+07	3.81	7.56	3	
08/05/97	75	5.0	7.0E+07	0.08	7.84	3	
08/07/97	73	5.0	1.1E+08	0.60	7.68	3	Compressor down
08/12/97	67	5.0	4.6E+07	8.74	7.58	3	Compressor fixed
08/13/97	67	5.0	1.0E+07	9.24	7.86	4	Lost nutrient flow
08/19/97	70	5.0		7.90	7.87	4	Restart flow, add yeast
08/21/97	75	3.0		5.86	7.79	0	
08/22/97	76	0.0	5.0E+07	1.35	7.78	4	
08/26/97	75	0.0	2.0E+07	0.38	7.58	3	Flow off over weekend
08/27/97	70	3.0	1.0E+07	1.43	7.34	3	Lost nutrient flow
08/29/97	75	3.0	6.0E+07	0.33	7.55	4	
09/02/97	75	3.0	2.0E+07	0.39	7.15	4	
09/03/97	74	3.5		0.34	7.29	4	
09/04/97	73	4.0	2.6E+08	0.32	7.37	4	
09/05/97	70	4.3	3.0E+08	0.37	7.48	4	
09/08/97	71	4.0	3.6E+08	0.34	7.37	5	
09/09/97	69	5.0	3.8E+08	0.35	7.53	5	
09/11/97	70	5.0	1.8E+08	0.34	7.84	5	Feeder off 12 hours, restart
09/12/97	67	5.0	1.6E+08	0.37	7.78	5	Agitator off
09/16/97	70	5.0	2.4E+08	4.55	7.65	5	
09/17/97	64	5.0	4.2E+08	0.37	7.46	5	
09/18/97	68	5.0	2.2E+08	0.35	7.35		
09/22/97	66	5.5	3.0E+08	4.47	7.81	4.5	Lost nutrient flow
09/24/97	65	5.0	3.4E+08	0.42	7.63	4.5	
09/25/97	67	5.0	4.6E+08	0.36	7.43	4.5	
09/26/97	64	5.0	3.2E+08	0.42	7.50	4.5	
09/29/97	65	5.0	2.2E+08	0.41	7.52	4.5	
09/30/97	66	5.0	2.6E+08	0.39	7.48	4.5	
10/01/97	69	5.0	3.8E+08	0.39	7.56	4.5	Shut-down bioreactor

resultant acidic pungent smell was the indicator of anaerobic conditions.

In addition to monitoring the bacterial population in the bioreactor, bacteria cell counts were measured in the pregnant solution to determine if bacteria addition to the pad was affecting the bacteria population at the bottom of the heap. Table 2 shows the pregnant solution bacteria population from April 21. 1997 through September 25, 1997. Bacteria populations varied significantly throughout bioremediation.

Table 2
Bacteria population in the VFL #3 pregnant solution

Date	Bacteria Population, cell/mL
4/21/97	55
6/02/97	8100
7/10/97	18000
7/23/97	4100
8/27/97	1300
9/11/97	4400
9/18/97	16900
9/25/97	2300

WAD Cyanide Detoxification During Water Rinsing and Bioremediation

During the period of bioreactor operation, June 16 to October 1, 1997, barren solution sprays were moved across the pad, inoculating the entire surface of VFL #3 with bacteria. Table 3 shows the volume of solution sprayed onto VFL #3 during bioreactor operation.

Table 3
Rinsate volumes applied to VFL #3 from June to September 1997

Month	Rinsate Applied, gallons	Areas of Application
June	19,475,500	North ⅓
July	29,958,000	North ⅓ and South ⅓
August	23,212,800	South ⅓ and Middle ⅓
September	24,364,800	Middle ⅓
Total	97,011,100	

Table 4 shows the WAD cyanide concentration, temperature, dissolved oxygen and pH of the

pregnant solution from the pad which was measured periodically by Compliance Technology. Figure 2 shows this data graphically. The WAD cyanide concentration in the pregnant solution was above 26 mg/L before initiation of bioremediation on June 16, 1997. This concentration decreased to below 0.6 mg/L by July 10 and remained in the range of 0.20 to 0.56 mg/L throughout the remaining period of bioremediation. The main reason the WAD cyanide concentration did not continue to decrease is that barren solution was applied to portions of the pad not yet inoculated with bacteria. This flushed out cyanide from areas not yet remediated. By the time bioremediation was suspended on October 1, 1997, the entire surface of the pad had seen bacteria inoculum and solution spray. The consistency in WAD cyanide analyses over several months gives some assurance that the WAD cyanide concentration is between 0.20 and 0.56 mg/L in the process solution throughout the entire pad.

The decrease in the WAD cyanide concentration of the pregnant solution may not be fully attributable to bioremediation. During rinsing of heap leach pads in general, free cyanide concentrations will decrease relatively quickly even without active treatment. Once the free cyanide is gone, the remaining cyanide is tied up in metal/cyanide complexes. For example, the VFL #3 process solution contained copper, nickel and mercury cyanide complexes. Based on the original concentrations of these metals in the VFL #3 process solution, the rate of cyanide detoxification should have significantly slowed when the WAD cyanide concentration reached 3 to 4 mg/L. The rate of cyanide detoxification did not slow until the WAD cyanide concentration reached 0.5 mg/L, indicating bioremediation may be partially responsible for the quick rate of cyanide detoxification.

Dissolved oxygen levels in the pregnant solution were generally less than 1 mg/L after June 30, 1997 indicating the oxygen was being consumed within the pad. Pumping through the process plant and spraying the pad reoxygenated the solution. Measurement of oxygen in the barren solution returning to the pad showed a near saturated concentration of 7 mg/L.

WAD Metals Reduction During Bioremediation

Metals analyses were conducted by AEC Laboratory (a State of Utah certified lab) on samples of pregnant solution every one to two weeks; analytical reports from AEC are appended to this report. Samples were analyzed for arsenic copper, mercury, nickel, and silver. Mercury was measured using hydride generation - atomic absorption; the other metals were analyzed using an inductively coupled plasma technique. The concentrations of metals which form WAD cyanide complexes (copper, mercury, nickel and silver) are shown in Table 5 and in Figures 3, 4 and 5. The concentrations of these metals decreased as a result of cyanide detoxification.

Table 4. WAD cyanide, dissolved oxygen, temperature and pH of VF-3 pregnant solution

Date	WAD CN, mg/L	Temp., C	Dissolved oxygen, mg/L	pH
04/21/97	46.5	7.9	5.02	8
06/02/97	26			
06/16/97	29	8.3	4.83	
06/19/97	5.0			
06/30/97	2.0	9.1	7.76	
07/10/97	0.31			
07/16/97	0.44	10.3	0.53	
07/23/97	0.42			
07/31/97	0.56	11.1	0.27	
08/13/97	0.41	9.3	0.55	
08/27/97	0.48	12.6	1.52	
09/04/97	0.20			
09/11/97	0.27	9.1	0.51	6.97
09/18/97	0.23	9.1	0.5	7.00
09/25/97	0.21	9.8	0.38	6.96
10/01/97	0.39			

Figure 2. WAD cyanide concentration in Barrick Mercur VF-3 pregnant solution

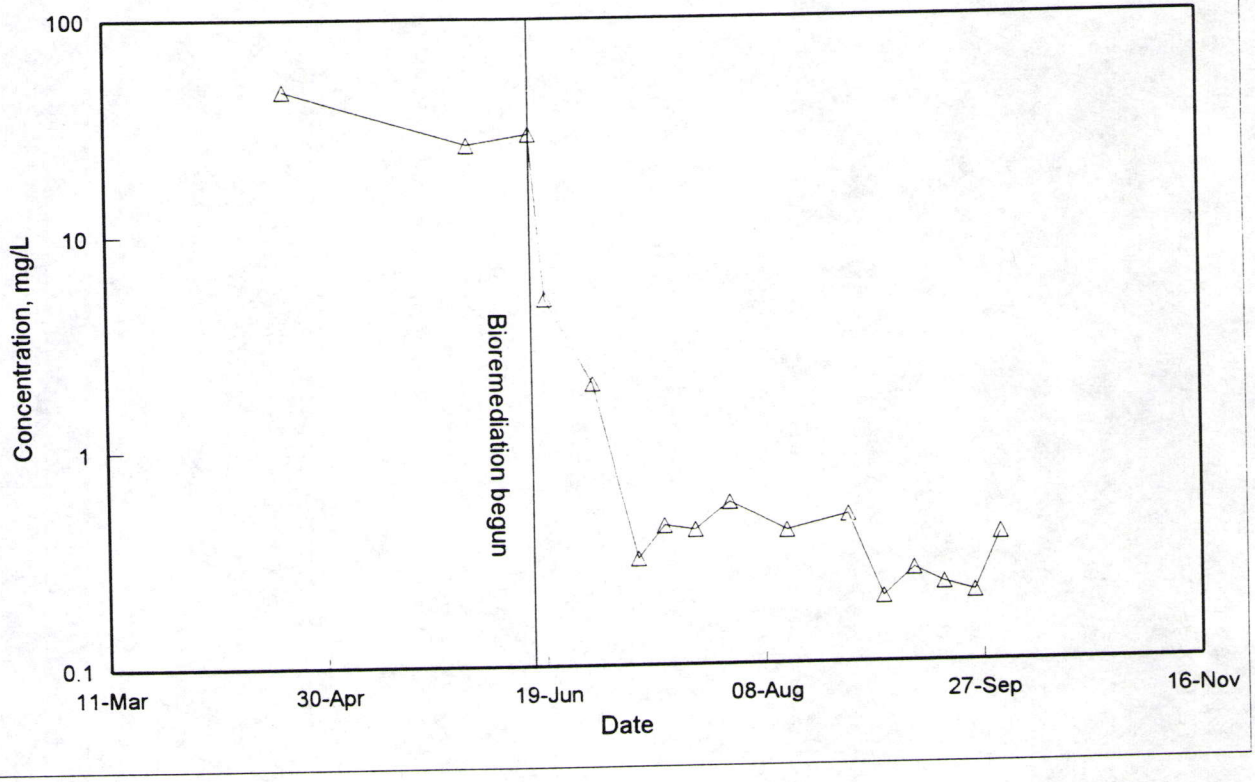


Table 5
Concentration of WAD cyanide metals and arsenic in the pregnant solution during bioremediation of Barrick Mercur's VFL #3 heap leach pad

Date	Silver mg/L	Copper mg/L	Mercury mg/L	Nickel mg/L	Arsenic mg/L	Comments
4/21/97	<0.05	0.91	1.235	1.3	1.1	
6/2/97	0.046	0.97	1.300	1.3	0.98	
6/16/97	0.033	0.49	0.620	1.2	0.95	Bioremediation begun
6/19/97	<0.05	0.33	0.678	1.1	0.84	
6/30/97	<0.05	<0.05	0.255	0.4	0.87	
7/10/97	<0.02	<0.05	0.012	<0.10	0.73	
7/16/97	<0.02	<0.05	0.0089	<0.10	0.84	
7/23/97	<0.02	0.088	0.0079	<0.10	0.73	
7/31/97	<0.02	0.031	0.0058	<0.05	0.84	
8/13/97	<0.05	<0.05	0.0054	<0.10	0.65	
8/27/97	<0.05	<0.05	0.0047	<0.10	0.69	
9/4/97	<0.05	<0.05	0.02	<0.10	0.89	
9/11/97	<0.05	<0.05	0.0024	<0.10	0.73	
9/18/97	<0.05	<0.05	0.0011	<0.10	0.36	
9/25/97	<0.05	<0.05	0.0021	<0.05	0.88	
10/1/97	<0.01*	0.018*	0.0028	0.02*	0.68	Bioreactor shut off

*Lower detection limits were obtained by ICP/mass spectroscopy

Copper. The concentration of copper in the pregnant solution decreased from about 1 mg/L to below the detection limit of 0.05 mg/L during bioremediation as shown in Figure 3. The sample taken on October 1, 1997 was analyzed by ICP/mass spectroscopy which gave a lower detection limit. The copper concentration in this sample was 0.018 mg/L.

Mercury. The mercury concentration in the process solution was above 1 mg/L during leaching and water rinsing. Once bioremediation was begun, the mercury concentration in the pregnant solution decreased to about 0.003 mg/L as shown in Figure 4. Reducing the mercury concentration is important due to the particularly low drinking water MCL of 0.002 mg/L.

Nickel. The nickel concentration decreased slowly from about 1.3 mg/L to less than the detection limit of 0.1 mg/L during the period of rinsing and bioremediation as shown in Figure 5. The final sample was analyzed by ICP/mass spectroscopy to lower the detection limit. The nickel concentration in this sample was 0.020 mg/L

Silver. The silver concentration in process solution was relatively low (<0.05mg/L)

before bioremediation and remained below detection limits throughout treatment.

Arsenic Concentration during Bioremediation

The arsenic concentration in the process solution remained between 0.36 and 1.1 mg/L during leaching and bioremediation as shown in Figure 6. In heap leach process solutions, arsenic is generally present as arsenite, AsO_2^-, or arsenate, AsO_4^{-3}, not as a cyanide complex; thus, cyanide bioremediation does not have a significant effect on reducing the arsenic concentration.

Conclusions

Several conclusions can be made from the data presented in this report, including:

- Cyanide-degrading bacteria were successfully grown and applied to the VFL #3 leach pad.
- The combination of natural degradation and bioremediation reduced the WAD cyanide concentration in the rinsate from all portions of VFL #3 to less than 0.56 mg/L.
- The concentrations of the WAD cyanide metals (copper, mercury, nickel and silver) were significantly reduced. The total concentration of these metals as of October 1, 1997 was less than 0.05 mg/L, indicating almost complete destruction of the WAD cyanide complexes.

Figure 3. Copper concentration in Barrick Mercur VF-3 pregnant solution

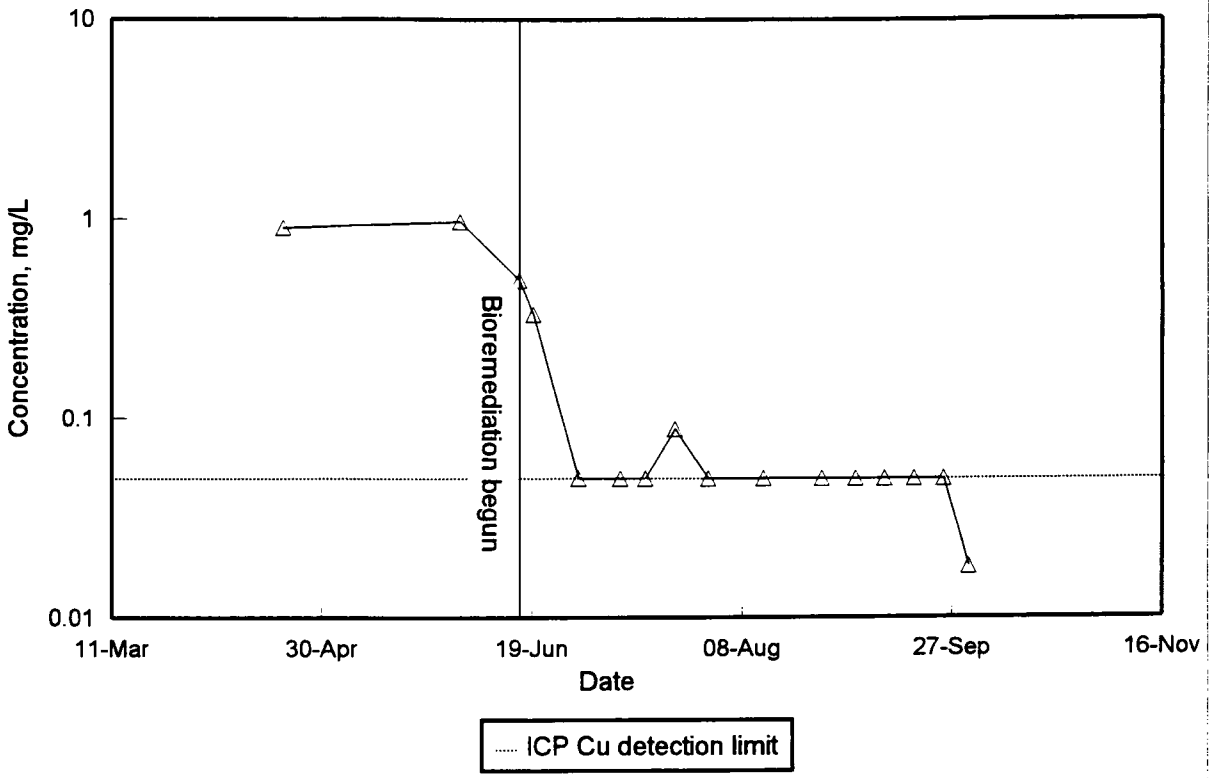


Figure 4. Mercury concentration in Barrick Mercur VF-3 pregnant solution

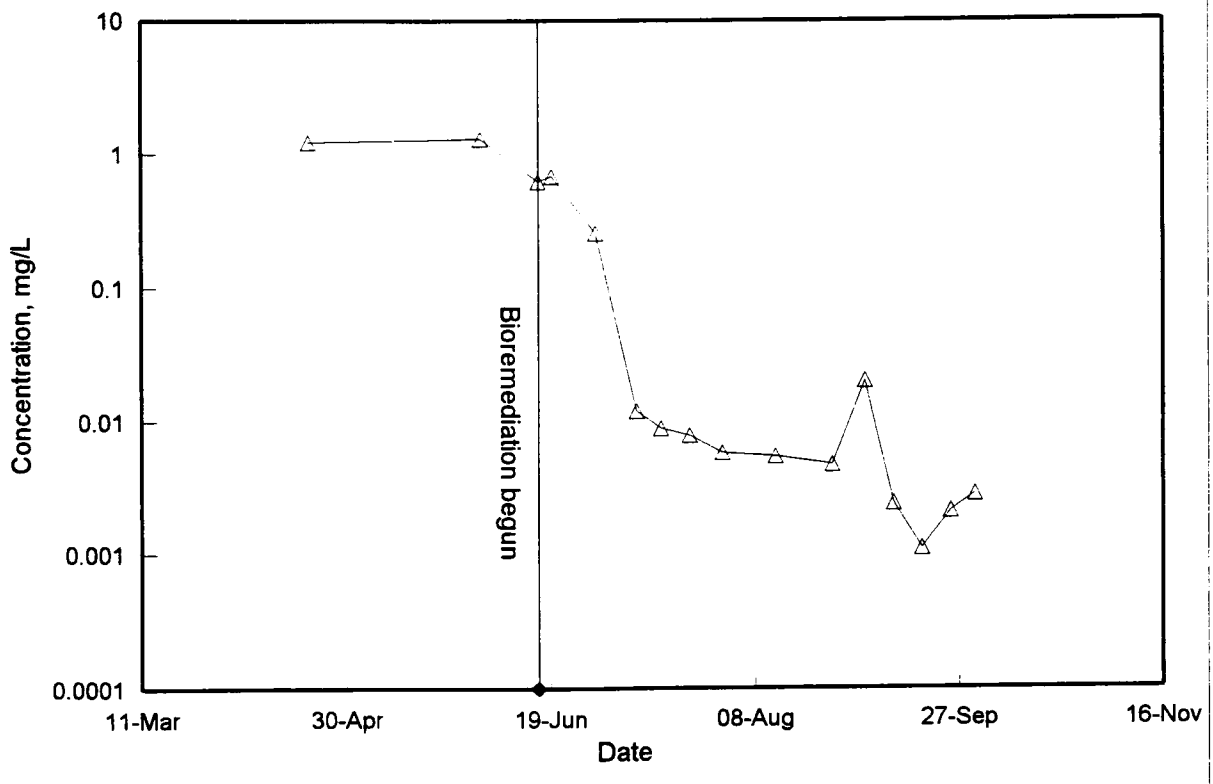


Figure 5. Nickel concentration in Barrick Mercur VF-3 pregnant solution

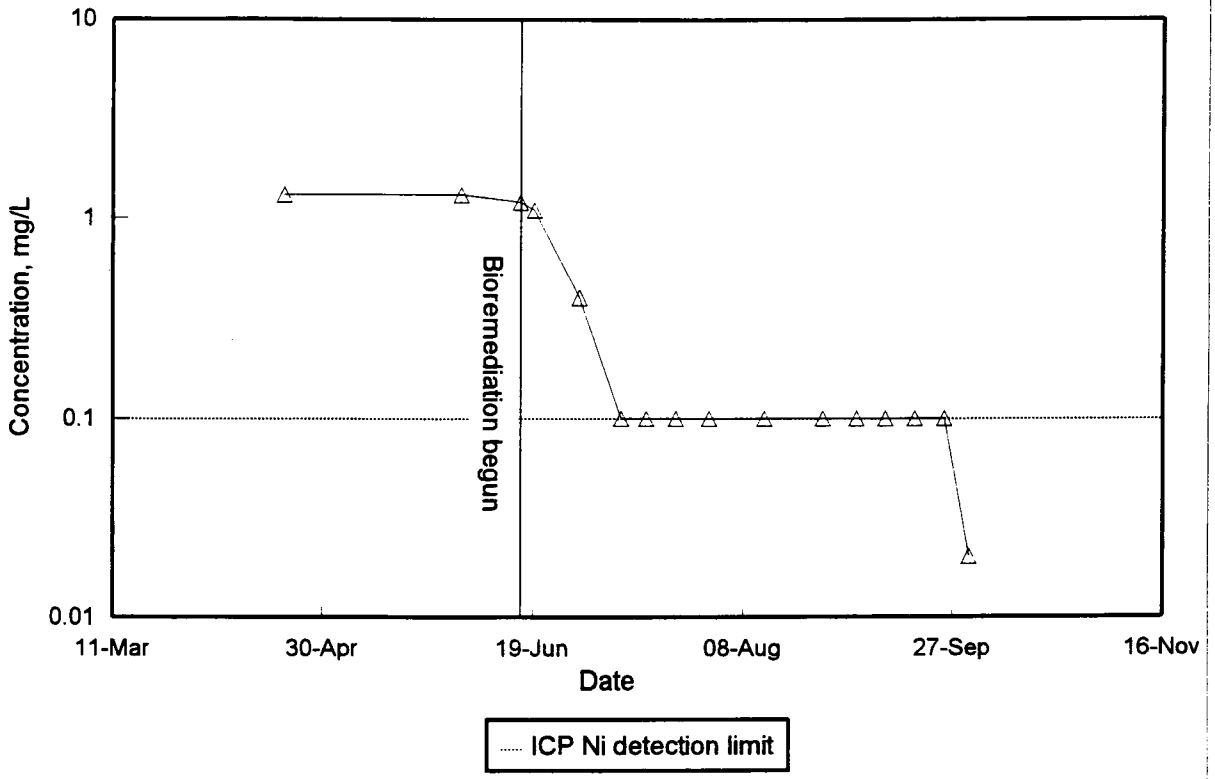
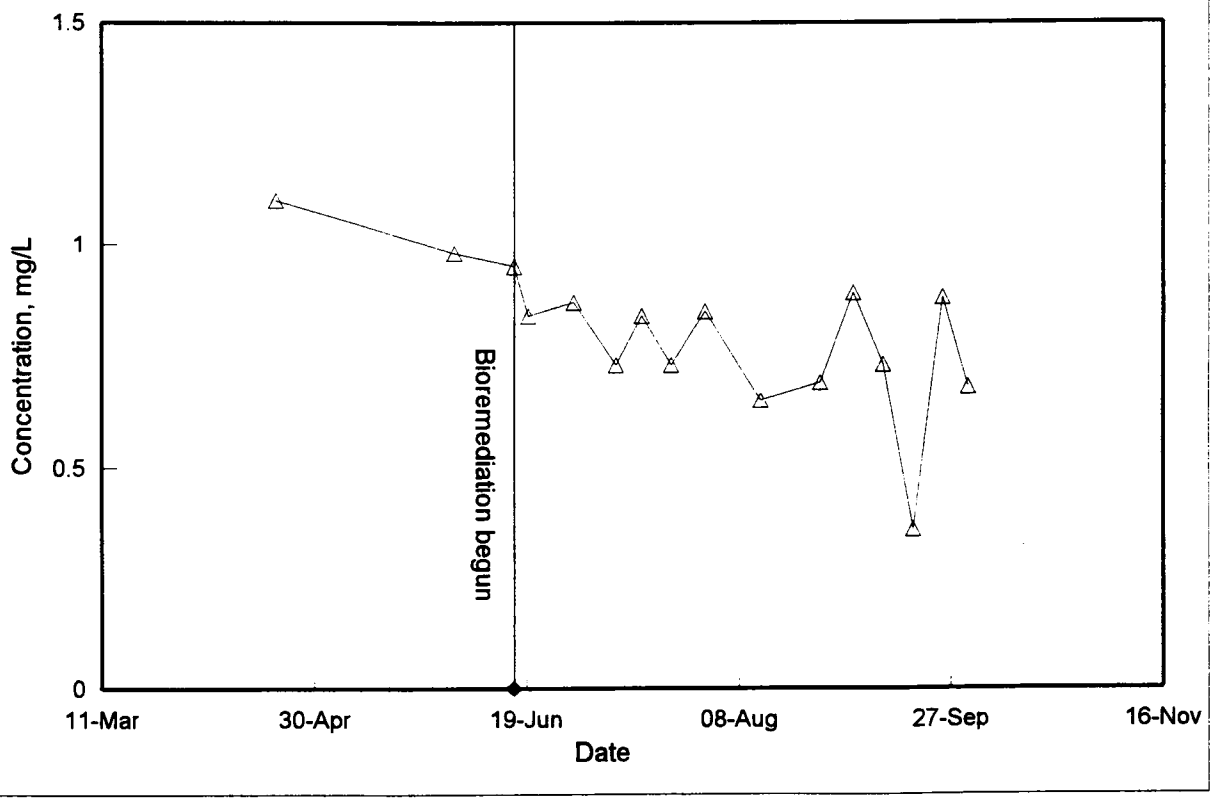


Figure 6. Arsenic concentration in Barrick Mercur VF-3 pregnant solution



AMERICAN ENVIRONMENTAL CONSULTANTS

ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L970829

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L970829-1	21-APR-97	BM 421	AG(D)	<.050	ppm	JT	24-APR-97	180	6010
			AS(D)	1.1	ppm	JT	24-APR-97	180	6010
			CU(D)	.91	ppm	JT	24-APR-97	180	6010
			HG(D)	1235.	ppb	VK	25-APR-97		245.1
			NI(D)	1.3	ppm	JT	24-APR-97	180	6010

Approved

Reviewer

AMERICAN ENVIRONMENTAL CONSULTANTS

ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L971232

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L971232-1	02-JUN-97	BM 602	AG(D)	.046	ppm	EBK	10-JUN-97	180	6010
			AS(D)	.98	ppm	EBK	10-JUN-97	180	6010
			CU(D)	.97	ppm	EBK	10-JUN-97	180	6010
			HG(D)	1.3	ppm	VPK	10-JUN-97		245.1
			NI(D)	1.3	ppm	EBK	10-JUN-97	180	6010

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ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L971363

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L971363-1	14-JUN-97	BM 616	AG(D)	.033	ppm	JJT	19-JUN-97	180	6010
			AS(D)	.95	ppm	JJT	19-JUN-97	180	6010
			CU(D)	.49	ppm	JJT	19-JUN-97	180	6010
			HG(D)	620	ppb	EBK	19-JUN-97		245.1
			NI(D)	1.2	ppm	JJT	19-JUN-97	180	6010

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ASARCO TECHNICAL SERVICES CENTER

ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L971460

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L971460-1	19-JUN-97	BM 619	AG(D)	<.05	ppm	LV	10-JUL-97	180	272.1
			AS(D)	.84	ppm	JJT	08-JUL-97	180	6010
			CU(D)	.33	ppm	LV	10-JUL-97	180	220.1
			HG(D)	678	ppb	VPK	10-JUL-97		245.1
			NI(D)	1.1	ppm	JJT	08-JUL-97	180	6010

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ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L971509

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L971509-1	30-JUN-97	BM 630	AG(D)	<.05	ppm	LV	10-JUL-97	180	272.1
			AS(D)	.87	ppm	JJT	08-JUL-97	180	6010
			CU(D)	<.05	ppm	LV	10-JUL-97	180	220.1
			HG(D)	255	ppb	VPK	10-JUL-97		245.1
			NI(D)	.40	ppm	JJT	08-JUL-97	180	6010

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ANALYTICAL DATA REPORT

Compliance Technology

(Project SELENIUM)

Batch No: L971618

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L971618-1	11-JUL-97	SE10711	NO2/NO3	41	ppm	LV	16-JUL-97	28	353.2
			SE	2.4	ppm	LV	23-JUL-97	180	6010
L971618-2	11-JUL-97	SE20711	NO2/NO3	49	ppm	LV	16-JUL-97	28	353.2
			SE	2.8	ppm	LV	23-JUL-97	180	6010
L971618-3	10-JUL-97	BM 710	AG	<.02	ppm	LV	23-JUL-97	180	6010
			AS	.73	ppm	LV	23-JUL-97	180	6010
			CU	<.05	ppm	LV	23-JUL-97	180	6010
			HG	12	ppb	LV	22-JUL-97	28	245.1
			NI	<.10	ppm	LV	23-JUL-97	180	6010

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Reviewer

ASARCO TECHNICAL SERVICES CENTER

ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L971671

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L971671-1	17-JUL-97	BM [redacted]-717	AG(D)	<.02	ppm	LV	23-JUL-97	180	6010
			AS(D)	.84	ppm	LV	23-JUL-97	180	6010
			CU(D)	<.05	ppm	LV	23-JUL-97	180	6010
			HG(D)	8.9	ppb	BD	25-JUL-97		245.1
			NI(D)	<.10	ppm	LV	23-JUL-97	180	6010

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ASARCO TECHNICAL SERVICES CENTER

ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L971739

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L971739-1	23-JUL-97	BM 723	AG(D)	<.02	ppm	JJT	06-AUG-97	180	6010
			AS(D)	.73	ppm	JJT	06-AUG-97	180	6010
			CU(D)	.088	ppm	JJT	06-AUG-97	180	6010
			HG(D)	7.2	ppb	BD	07-AUG-97		245.1
			NI(D)	<.10	ppm	JJT	06-AUG-97	180	6010

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ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L971820

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L971820-1	31-JUL-97	BM 731	AG(D)	<.020	ppm	EBK	15-AUG-97	180	6010
			AS(D)	.85	ppm	EBK	15-AUG-97	180	6010
			CU(D)	.031	ppm	EBK	15-AUG-97	180	6010
			HG(D)	5.8	ppb	LV	07-AUG-97		245.1
			NI(D)	<.050	ppm	EBK	15-AUG-97	180	6010

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ASARCO TECHNICAL SERVICES CENTER

ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L971923

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L971923-1	13-AUG-97	BM 813	AG(D)	<.05	ppm	LV	19-AUG-97	180	6010
			AS(D)	.65	ppm	LV	19-AUG-97	180	6010
			CU(D)	<.05	ppm	LV	19-AUG-97	180	6010
			HG(D)	5.4	ppb	LV	18-AUG-97		245.1
			NI(D)	<.10	ppm	LV	19-AUG-97	180	6010

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Reviewer

ASARCO TECHNICAL SERVICES CENTER

ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L972068

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L972068-1	27-AUG-97	BM 827	AG(D)	<.05	ppm	LV	10-SEP-97	180	6010
			AS(D)	.69	ppm	LV	10-SEP-97	180	6010
			CU(D)	<.05	ppm	LV	10-SEP-97	180	6010
			HG(D)	4.7	ppb	LV	11-SEP-97		245.1
			NI(D)	<.10	ppm	LV	10-SEP-97	180	6010

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ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L972132

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L972132-1	04-SEP-97	BM 904	AG(D)	<.05	ppm	LV	10-SEP-97	180	6010
			AS(D)	.89	ppm	LV	10-SEP-97	180	6010
			CU(D)	<.05	ppm	LV	10-SEP-97	180	6010
			HG(D)	20	ppb	LV	11-SEP-97		245.1
			NI(D)	<.10	ppm	LV	10-SEP-97	180	6010

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ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L972198

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L972198-1	11-SEP-97	BM 911	AG(D)	<.05	ppm	LV	24-SEP-97	180	6010
			AS(D)	.73	ppm	LV	24-SEP-97	180	6010
			CU(D)	<.05	ppm	LV	24-SEP-97	180	6010
			HG(D)	2.4	ppb	BD	16-SEP-97		245.1
			NI(D)	<.10	ppm	LV	24-SEP-97	180	6010

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AMERICAN ENVIRONMENTAL CONSULTANTS

ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L972250

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L972250-1	18-SEP-97	BM 918	AG	<.050	ppm	KB	30-SEP-97	180	6020
			AS	.36	ppm	KB	30-SEP-97	180	6020
			CU(D)	<.050	ppm	DC	25-SEP-97	180	220.1
			HG	1.1	ppb	BD	01-OCT-97	28	245.1
			NI	<.050	ppm	KB	30-SEP-97	180	6020
			WADCN-	.45	ppm	DC	25-SEP-97		ASTM D-2036-81 METH.C

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Reviewer

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ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L972321

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L972321-1	25-SEP-97	BM 925	AG(D)	<.05	ppm	LV	10-OCT-97	180	6010
			AS(D)	.88	ppm	LV	10-OCT-97	180	6010
			CU(D)	<.05	ppm	LV	10-OCT-97	180	6010
			HG(D)	2.1	ppb	LV	08-OCT-97		245.1
			NI(D)	<.10	ppm	LV	10-OCT-97	180	6010
			WADCN-	.31	ppm	DC	09-OCT-97		ASTM D-2036-81 METH.C

Approved

Ken Bilak
Reviewer

AMERICAN ENVIRONMENTAL CONSULTANTS

ANALYTICAL DATA REPORT

Compliance Technology

(Project BARRICK)

Batch No: L972366

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L972366-1	01-OCT-97	BM 1001	AG(D)	<.010	ppm	DC	06-OCT-97	180	6010
			AS(D)	.68	ppm	DC	06-OCT-97	180	6010
			CU(D)	.018	ppm	DC	06-OCT-97	180	6010
			HG(D)	2.8	ppb	LV	08-OCT-97		245.1
			NI(D)	.020	ppm	DC	06-OCT-97	180	6010
			WADCN-	.81	ppm	DC	03-OCT-97		ASTM D-2036-81 METH.C

Approved

Reviewer

APENDIX B TO FINAL CLOSURE PLAN
GROUND WATER QUALITY DISCHARGE PERMIT
UGW450001

DEWATERING WELL (DW-20) INSTALLATION
VALLEY FILL LEACH AREA #3
BARRICK RESOURCES (USA) Inc. - MERCUR MINE
FINAL REPORT

DEWATERING WELL (DW-20) INSTALLATION
VALLEY FILL LEACH AREA #3
BARRICK RESOURCES (USA) Inc. - MERCUR MINE
FINAL REPORT

December 21, 1997

GLOBAL ENVIRONMENTAL TECHNOLOGIES, L.L.C.
Salt Lake City, Utah

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1.0 INTRODUCTION

On October 27, 1997, Barrick Mercur Mine completed the installation of a vertical dewatering well (DW-20) at the Mercur Mine Valley Fill Leach Area #3 (VFL3). The concept of the dewatering well was modeled in the "Infiltration and Solute Transport Analysis, Valley Fill Area #3, Barrick Mercur Mine" dated August 15, 1996, included as an attachment to the Interim Conceptual Closure Plan for VFL3, submitted in August 1996. The plan was approved by the Utah Division of Water Quality (UDWQ) on May 23, 1997. The installation of the dewatering well was discussed during a joint meeting between Barrick and the UDWQ on June 4, 1997, and the specifications for the well and engineering drawings were presented in a document to the UDWQ on June 15, 1997.

The purpose of the well is to provide maximum dewatering capability to VFL3 following cessation of leaching and sub ore neutralization, and to minimize the potential for infiltration through the liner during closure and following placement of the engineered cover. Operation of the dewatering well is expected to follow the modeled duration used in VFL3 infiltration model.

The well was located using VFL3 as-built drawings and survey datum taken during the construction of VFL3. As-built drawings were used to provide the location of the deepest portion of the permanent process pool, and to ascertain elevations for the liner and the top of the Golden Gate Tailing Blanket. The boring was collared at a surveyed elevation of 7211.37 feet msl at coordinates N. 27303.13, E. 20891.14. This location was confirmed by a licensed professional surveyor prior to initiation of drilling. Barrick provided access to this location and constructed a drill pad location prior to drilling. Location of the well is shown on Figure 1.

The well bore was advanced through approximately 170 feet of leached sub ore that was loosely consolidated to unconsolidated. Spent ore materials rest on historic Golden Gate Tailing, used as a blanket liner. This is shown on as-built drawings to have a thickness of

4 to 5 feet, and directly overlies a polyethylene flexible membrane liner (FML).

VFL3 covers approximately 26 acres. The facility is located in the southern end of the Oquirrh Mountain Range in Meadow Canyon, within the northwest quarter of Section 5, Township 6 South, Range 3 West, and the south-west quarter of Section 32, Township 5 South, Salt Lake Base and Meridian. VFL3 has been in operation since December 1990.

1.1 Scope of Work

Barrick contracted the drilling, well installation, and well development for the dewatering well. Barrick issued technical specifications for well construction to the drilling contractor. Well drilling was performed by Layne Christensen of Salt Lake City, Utah. Well construction oversight, development, testing and sampling of the neutralized process water was performed by Global Environmental Technologies (GET) personnel. Barrick contracted the laboratory analysis to CHEMTECH Ford Chemical Laboratory in Salt Lake City, Utah. GET provided quality assurance, engineering and geological services during the field activities. The objectives of services provided by GET were to:

- Observe drilling and well construction activities in order to provide Barrick with quality assurance control, and;
- Collect and evaluate technical information.

The scope of services performed by GET included:

- Observation of drilling and well construction activities to evaluate conformance with technical specifications for dewatering well DW-20;
- Observation of well drilling to document that the optimum depth of drilling had been achieved, and the boring did not penetrate the liner materials;
- Development and pump installation;
- Compilation and interpretation hydrologic information. The boring was logged and hydraulic conditions were evaluated following the performance of well testing;

- Preparation of this summary report. Details of field activities are included in the appendices.

2.0 FIELD ACTIVITIES

Field activities included technical observation of the drilling and installation of well DW-20 and performance of well testing. Water quality samples were collected during the specific capacity test by GET. The results of the initial water quality analysis are presented in this report in Attachment A.

2.1 Drilling and Well Construction

Drilling, well installation, well development, and well testing were performed by Layne Christensen Drilling of Salt Lake City as contracted directly with Barrick. The boring was drilled with a Schramm 685 drill rig using ODEX reverse drilling methods. Drilling fluids included only air. The boring was drilled to a total depth of 174.7 feet below grade, and the outer ODEX casing was advanced directly behind the drill bit to avoid collapse of the loosely consolidated sub ore materials. Ore materials consisted of sand to boulder size particles that were loaded onto the valley fill through dumping from trucks. Air monitoring for cyanide was conducted throughout drilling and well construction activities. Air monitoring indicated that no cyanide was encountered in the boring during drilling or construction of the well.

The well was constructed using 6-inch Schedule 80 PVC materials in accordance with specifications issued by Barrick. No significant unforeseen conditions were encountered, and no modifications were made to construction procedures. Figure 2 shows the schematic construction details of the well.

Ten–inch ODEX casing was advanced through the neutralized ore to a depth of 173 feet. At this depth, drilling characteristics indicated that a softer (Golden Gate Tailing blanket) had been intercepted, which was confirmed by the nature of the return cuttings from the cyclone. Drilling commenced for approximately 1 additional foot into the tailing material.

The 10-inch casing was left in place, and a Mills Knife was lowered to the bottom of the casing. Four knife slots per foot of steel casing section were made between depths of 174 to 154 feet below grade.

The 20-foot section of PVC screen was lowered into the steel casing, with stainless steel centralizers attached at the base, middle and top of the screen. A PVC end cap was used to close the bottom of the screened assembly. Screen slot size was 0.040 inches. The screen was gravel packed using tremie methods. The gravel pack was a 8-16 clean-washed Colorado Silica Sand, which extended from the bottom of the boring to 138.5 feet below grade. A 6-foot bentonite pellet seal was placed directly on the gravel pack to a depth of 132.5 feet. A neat-cement grout, placed using tremie methods was used to seal the well to the surface.

2.2 Well Development and Testing

The well was developed initially using a bailer to remove development sand and fine materials generated during the drilling of the boring. Water discharged from the well was collected in a container and inspected for the presence of sand pack and cuttings materials. Development was considered complete when the presence of these materials was negligible.

Attachment B contains detailed information on well development and testing. A short-term specific capacity test was conducted to provide estimates of specific capacity for the well in order to size pump requirements. The well was initially pumped at a constant rate. Throughout the testing, the pumping rate was increased and held in order to assess the changes in drawdown relative to the changes in pumping. Water levels initially dropped during each step of increase in discharge rate, but then began to recover as the increased rate was held constant. This recovery made assessment hydraulic parameters, such as transmissivity or hydraulic conductivity difficult to estimate with any degree of reliability. Water levels were measured periodically using an electric water level probe. Well DW-20 was pumped at rates varying from of approximately 13.5 to 22 gpm,

the fullest capacity of the pump.

2.3 Water Level Measurements

Prior to and after well completion and development, depth to water was measured using an electric probe and measuring to the nearest 0.01 foot. Water levels fluctuated between 162.15 to 163.50 feet below grade.

2.4 Water Quality Sampling

Water quality samples were collected by GET during the test on October 28, 1997. An initial sample was obtained at the beginning of the specific capacity test (DW-20-0), and then at approximately 2 hours into the test (sample DW-20-45), and a final set (DW-20-90) obtained after about 4.5 hours of pumping. Samples were analyzed by CHEMTECH Ford Analytical Laboratory of Salt Lake City, Utah. Attachment A contains water quality analyses for well DW-20.

Based upon the October 28, 1997 sampling analytical results of well DW-20, water quality indicates the following:

- The pH of the water remained constant at 7.10 throughout the test, and;
- Weak acid dissociable (WAD) cyanide concentrations consistently dropped throughout the test, from 0.70 mg/l to 0.082 mg/l at the end of the test.

3.0 SUMMARY AND CONCLUSIONS

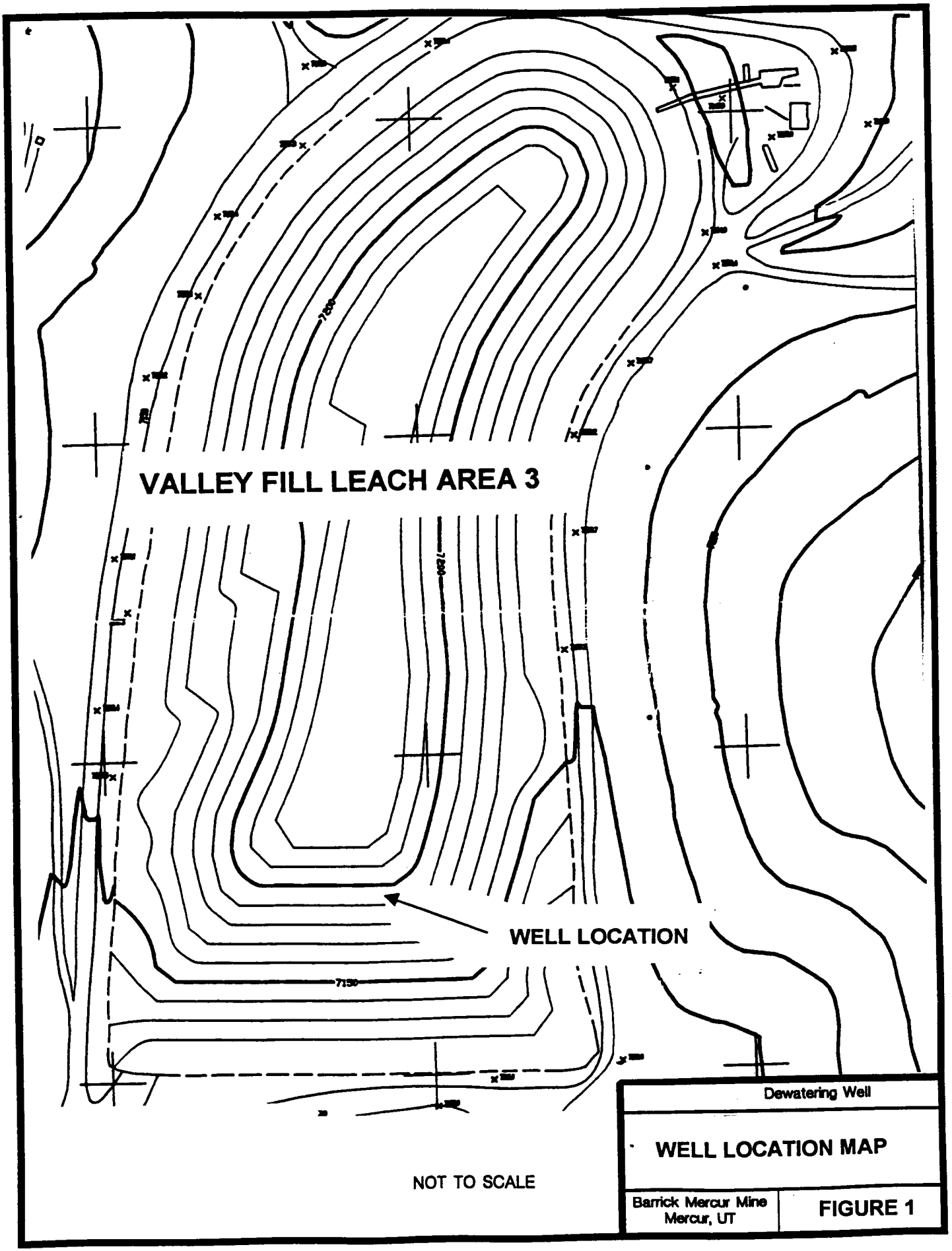
Results and conclusions of this study are summarized as follows:

1. Well DW-20 was drilled through neutralized sub ore to a total depth of 174 feet where the Golden Gate Tailing blanket was intercepted. The VFL3 liner was not reached or disturbed during drilling or construction.

2. Completed installation depth of the vertical dewatering well will allow for essentially complete dewatering of VFL3 to a level above the liner that was modeled in the Infiltration and Solute Transport Analysis submitted with the August 1996 Conceptual Closure Plan for VFL3.

3. DW-20 was pumped at rates up to 22 gpm. Specific capacity was estimate to be 13 gpm per foot of drawdown at the end of the test. Hydraulic conductivity could not be estimated from the data.

4. Measurements of pH and cyanide-WAD obtained from the final water samples during the specific capacity test indicate that the neutralization of the sub ore through bioremediation techniques achieved the goals of the neutralization for both parameters.



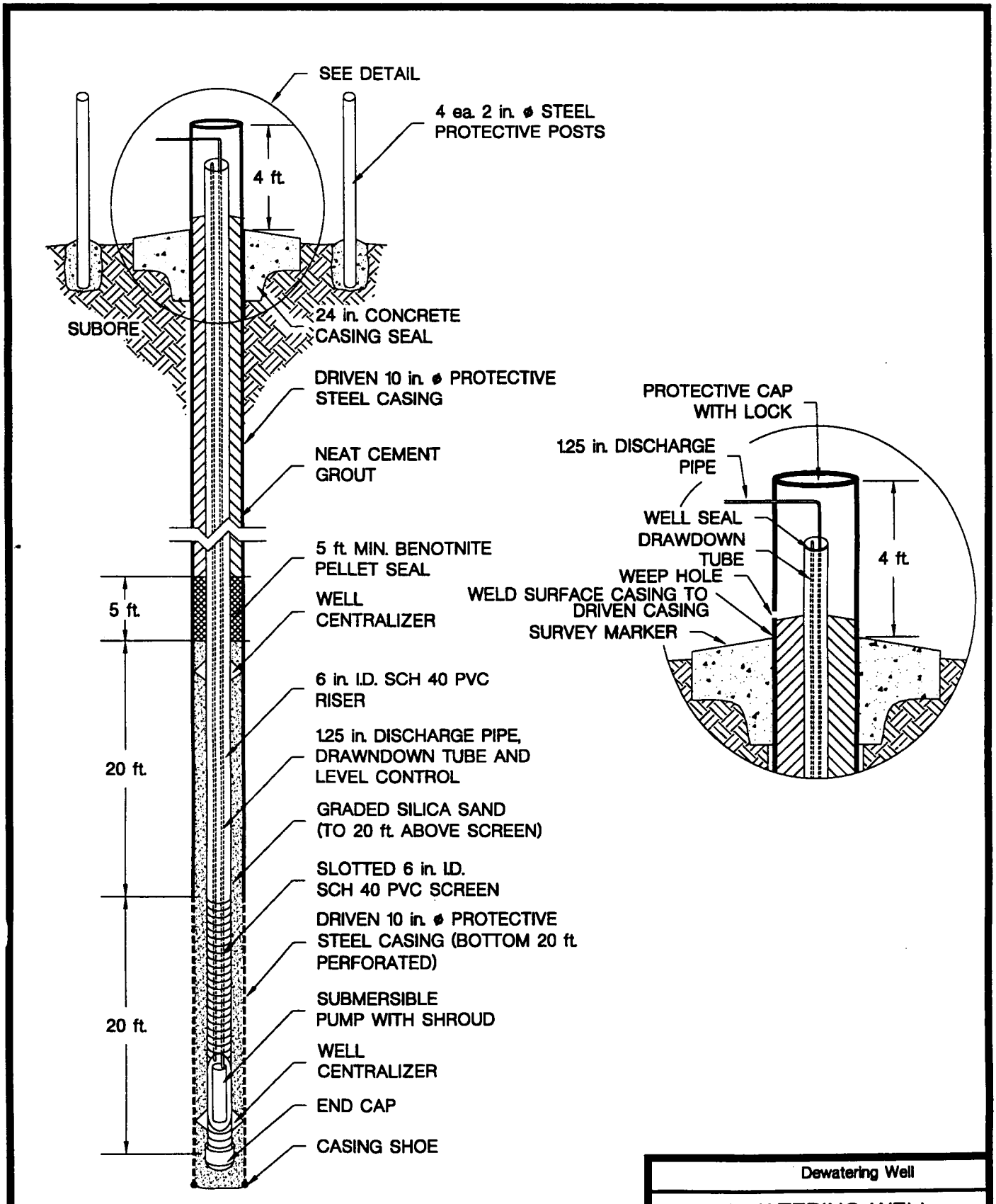
Dewatering Well

WELL LOCATION MAP

NOT TO SCALE

Barrick Mercur Mine
Mercur, UT

FIGURE 1



Dewatering Well

DEWATERING WELL CONSTRUCTION SCHEMATIC

Barrick Mercur Mine
Mercur, UT

FIGURE 2

ATTACHMENT A

WATER QUALITY
CERTIFICATES OF ANALYSIS

CHEMTECH-FORD

Date: 11/19/97

To: Barrick Mercur Gold Mine
attn. Dave Beatty
P.O. Box 838
Tooele, UT 84074-4447

Group #: 19275
Lab #: 97-U012056
Project: VLF 3 DEWATER WELL
Sample Desc: DW-20-0

Date Sampled: 10/28/97
Date Submitted: 10/29/97

Time Sampled: 11:40
Time Received: 16:02

CERTIFICATE OF ANALYSIS

PARAMETER	RESULT	MDL	DATE ANALYZED	METHOD	ANALYST
INORGANIC PARAMETERS					
Bicarbonate as HCO3, mg/L	334	1	11/ 3/97 14:00	SM 2320B	TM
Carbonate as CO3, mg/L	< 1	1	11/ 3/97 14:00	SM 2320B	TM
Hydroxide as OH, mg/L	< 1	1	11/ 3/97 14:00	SM 2320B	TM
Alkalinity, Total (CaCO3), mg/L	274	1	11/ 3/97 14:00	SM 2320B	TM
Ammonia-Nitrogen, mg/L	7.0	0.2	11/ 7/97 9:00	SM 4500G/F	TM
Chloride (D), mg/L	420	1	11/ 3/97 12:30	EPA 325.3	TM
Chromium, Hexavalent, mg/L	< 0.02	0.02	10/31/97 10:45	SM18,3500D	TM
Conductance, Specific, umhos/cm	941.5	0.1	11/ 5/97 9:00	EPA 120.1	KRF
Cyanide, Amenable to Cl2, mg/L	3.51	0.002	11/13/97 16:00	ASTM D2036	TPH
Cyanide, Free, mg/L	0.32	0.01	11/13/97 16:00	ASTM D2036	TPH
Cyanide (T), mg/L	3.6	0.1	11/11/97 16:00	ASTM D2036	TPH
Cyanide, WAD, mg/L	0.70	0.02	11/11/97 16:00	ASTM D2036	TPH
Fluoride, mg/L	0.6	0.1	10/31/97 12:00	EPA 340.2	EG
Hardness, EDTA Titration, mg/L	1,690	25	11/ 4/97 8:00	EPA 130.2	TM
Hardness Index: Very Hard Water					
Hardness, (n-carb), mg/L	1,356	25		CAL	
Hardness, (calc), mg/L	1,520	25		CAL	
Mercury (T), as Hg, mg/L	0.0038	0.0002	11/ 3/97 13:29	EPA 245.1	EG
Mercury, as Hg (D), mg/L	0.0035	0.0002	11/ 3/97 13:29	EPA 245.1	EG
Nitrate, Nitrogen, mg/L	300	80	11/ 5/97	EPA 353.1	LH

Approved By: _____

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CHEMTECH-FORD ANALYTICAL LABORATORIES

Date: 11/19/97

To: Barrick Mercur Gold Mine
attn. Dave Beatty
P.O. Box 838
Tooele, UT 84074-4447

Group #: 19275
Lab #: 97-U012056
Project: VLF 3 DEWATER WELL
Sample Desc: DW-20-0

Date Sampled: 10/28/97 Time Sampled: 11:40
Date Submitted: 10/29/97 Time Received: 16:02

CERTIFICATE OF ANALYSIS

PARAMETER	RESULT	MDL	DATE ANALYZED	METHOD	ANALYST
INORGANIC PARAMETERS					
Nitrite, Nitrogen, mg/L	4.5	0.5	10/31/97 10:45	EPA 354.1	TM
Nitrate/Nitrite-Nitrogen, mg/L	305	80	11/ 5/97	EPA 353.1	LH
pH, units	7.10	0.05	10/29/97 17:00	EPA 150.1	LS
Phosphorus, Total, mg/L	0.44	0.05	11/ 6/97 9:00	SM 4500-P	TM
Sulfate, mg/L	3,500	1000	11/12/97 11:00	EPA 375.4	TM
Total Dissolved Solids, mg/L	7,950	10	11/ 4/97 15:00	EPA 160.1	LS
Total Suspended Solids, mg/L	8	1	10/29/97 17:00	EPA 160.2	LS
Turbidity, NTU	4.89	0.05	10/29/97 17:00	EPA 180.1	LS
Aluminum (T), as Al, mg/L	< 0.03	0.03	11/ 3/97 10:48	EPA 200.7	LH
Aluminum (D), as Al, mg/L	< 0.03	0.03	11/ 3/97 10:48	EPA 200.7	LH
Arsenic (T), as As, mg/L	1.13	0.06	11/ 3/97 10:49	EPA 200.7	LH
Arsenic (D), as As, mg/L	0.86	0.06	11/ 3/97 10:49	EPA 200.7	LH
Barium (T), as Ba, mg/L	< 0.005	0.005	11/ 3/97 10:48	EPA 200.7	LH
Barium (D), as Ba, mg/L	0.008	0.005	11/ 3/97 10:48	EPA 200.7	LH
Boron (T), as B, mg/L	< 0.05	0.05	11/ 3/97 10:48	EPA 200.7	LH
Calcium (T), as Ca, mg/L	532	2	11/ 3/97 10:48	EPA 200.7	LH
Chromium(T), as Cr, mg/L	< 0.005	0.005	11/ 3/97 10:48	EPA 200.7	LH
Chromium (D), as Cr, mg/L	< 0.005	0.005	11/ 3/97 10:48	EPA 200.7	LH
Copper (T), as Cu, mg/L	< 0.01	0.01	11/ 3/97 10:48	EPA 200.7	LH
Copper (D), as Cu, mg/L	< 0.01	0.01	11/ 3/97 10:48	EPA 200.7	LH

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SALT LAKE CITY UTAH 84107 6905
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CHEMTECH-FORD ANALYTICAL LABORATORIE

Date: 11/19/97

To: Barrick Mercur Gold Mine
attn. Dave Beatty
P.O. Box 838
Tooele, UT 84074-4447

Group #: 19275
Lab #: 97-U012056
Project: VLF 3 DEWATER WELL
Sample Desc: DW-20-0

Date Sampled: 10/28/97
Date Submitted: 10/29/97

Time Sampled: 11:40
Time Received: 16:02

CERTIFICATE OF ANALYSIS

PARAMETER	RESULT	MDL	DATE ANALYZED	METHOD	ANALYST
INORGANIC PARAMETERS					
Gold (T), as Au, mg/L	0.04	0.02	11/ 6/97 12:00	EPA 200.7	LH
Gold (D), as Au, mg/L	0.04	0.02	11/ 6/97 12:00	EPA 200.7	LH
Iron (T), as Fe, mg/L	1.14	0.02	11/ 3/97 10:48	EPA 200.7	LH
Iron (D), as Fe, mg/L	0.78	0.02	11/ 3/97 10:48	EPA 200.7	LH
Magnesium (T), as Mg, mg/L	80.5	0.1	11/ 3/97 10:48	EPA 200.7	LH
Magnesium (D), as Mg, mg/L	76.4	0.1	11/ 3/97 10:48	EPA 200.7	LH
Manganese (T), as Mn, mg/L	1.81	0.01	11/ 3/97 10:48	EPA 200.7	LH
Manganese (D), as Mn, mg/L	1.74	0.01	11/ 3/97 10:48	EPA 200.7	LH
Nickel (T), as Ni, mg/L	0.04	0.01	11/ 3/97 10:48	EPA 200.7	LH
Nickel (D), as Ni, mg/L	0.04	0.01	11/ 3/97 10:48	EPA 200.7	LH
Potassium (T), as K, mg/L	20.7	0.1	11/ 3/97 10:48	EPA 200.7	LH
Selenium (T), as Se, mg/L	0.23	0.08	11/ 3/97 10:49	EPA 200.7	LH
Selenium (D), as Se, mg/L	0.22	0.08	11/ 3/97 10:49	EPA 200.7	LH
Silicon Dioxide, mg/L	21.0	0.2	11/ 3/97 10:48	EPA 200.7	LH
Silver (T), as Ag, mg/L	< 0.005	0.005	11/ 3/97 10:48	EPA 200.7	LH
Silver (D), as Ag, mg/L	< 0.005	0.005	11/ 3/97 10:48	EPA 200.7	LH
Sodium (T), as Na, mg/L	1,660	20	11/ 3/97 10:48	EPA 200.7	LH
Thallium (T), as Tl, mg/L	0.3	0.15	11/ 3/97 10:49	EPA 200.7	LH
Thallium (D), as Tl, mg/L	0.2	0.15	11/ 3/97 10:49	EPA 200.7	LH
Zinc (T), as Zn, mg/L	0.02	0.01	11/ 3/97 10:48	EPA 200.7	LH

Approved By: _____

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SALT LAKE CITY UTAH 84107 6905
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CHEMTECH-FORD ANALYTICAL LABORATORIES

Date: 11/19/97

To: Barrick Mercur Gold Mine
attn. Dave Beatty
P.O. Box 838
Tooele, UT 84074-4447

Group #: 19275
Lab #: 97-U012056
Project: VLF 3 DEWATER WELL
Sample Desc: MW-20-0

Date Sampled: 10/28/97
Date Submitted: 10/29/97

Time Sampled: 11:40
Time Received: 16:02

CERTIFICATE OF ANALYSIS

PARAMETER	RESULT	MDL	DATE ANALYZED	METHOD	ANALYST
INORGANIC PARAMETERS					
Zinc (D), as Zn, mg/L	0.01	0.01	11/ 3/97 10:48	EPA 200.7	LH
Cadmium (T), as Cd, mg/L	< 0.001	0.001	11/ 6/97 10:56	EPA 200.9	EG
Cadmium, (D) as Cd, mg/L	< 0.001	0.001	11/ 6/97 10:56	EPA 200.9	EG
Lead (T), as Pb, mg/L	0.011	0.005	11/ 6/97 13:57	EPA 200.9	EG
Lead,(D) as Pb, mg/L	0.008	0.005	11/ 6/97 13:57	EPA 200.9	EG
Cation, meq/L	105.6				
Anion, meq/L	95.20				
% Difference, %	-5.16				
Receiving Temperature, C	0.1		10/29/97 16:02		RCG

NOTE: Sample submitted on ice.
Sample submitted past holding time for Cr(Hex).
Suspended matter in metals container thus having an affect on cation/anion balance
20 hrs holding time left on NO2 when submitted
missed hold time for NO2

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Date: 11/19/97

To: Barrick Mercur Gold Mine
attn. Dave Beatty
P.O. Box 838
Tooele, UT 84074-4447

Group #: 19275
Lab #: 97-U012057
Project: VLF 3 DEWATER WELL
Sample Desc: MW-20-45

Date Sampled: 10/28/97
Date Submitted: 10/29/97

Time Sampled: 13:30
Time Received: 16:02

CERTIFICATE OF ANALYSIS

PARAMETER	RESULT	MDL	DATE ANALYZED	METHOD	ANALYST
INORGANIC PARAMETERS					
Bicarbonate as HCO3, mg/L	351	1	11/ 3/97 14:00	SM 2320B	TM
Carbonate as CO3, mg/L	< 1	1	11/ 3/97 14:00	SM 2320B	TM
Hydroxide as OH, mg/L	< 1	1	11/ 3/97 14:00	SM 2320B	TM
Alkalinity, Total (CaCO3), mg/L	288	1	11/ 3/97 14:00	SM 2320B	TM
Ammonia-Nitrogen, mg/L	8.4	0.2	11/ 7/97 9:00	SM 4500G/F	TM
Chloride (D), mg/L	406	1	11/ 3/97 12:30	EPA 325.3	TM
Chromium, Hexavalent, mg/L	< 0.02	0.02	10/31/97 10:45	SM18,3500D	TM
Conductance, Specific, umhos/cm	9,461	0.1	11/ 5/97 9:00	EPA 120.1	KRF
Cyanide, Amenable to Cl2, mg/L	3.63	0.01	11/13/97 16:00	ASTM D2036	TPH
Cyanide, Free, mg/L	0.33	0.01	11/13/97 16:00	ASTM D2036	TPH
Cyanide (T), mg/L	4.0	0.1	11/11/97 16:00	ASTM D2036	TPH
Cyanide, WAD, mg/L	0.2	0.1	11/11/97 16:00	ASTM D2036	TPH
Fluoride, mg/L	0.6	0.1	10/31/97 12:00	EPA 340.2	EG
Hardness, EDTA Titration, mg/L	1,700	50	11/ 4/97 8:00	EPA 130.2	TM
Hardness Index: Very Hard Water					
Hardness, (n-carb), mg/L	1,349	50		CAL	
Hardness, (calc), mg/L	1,470	50		CAL	
Mercury (T), as Hg, mg/L	0.0065	0.0002	11/ 3/97 13:29	EPA 245.1	EG
Mercury, as Hg (D), mg/L	0.0031	0.0002	11/ 3/97 13:29	EPA 245.1	EG
Nitrate, Nitrogen, mg/L	300	80	11/ 5/97	EPA 353.1	LH

Approved By: _____

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Date: 11/19/97

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P.O. Box 838
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Group #: 19275
Lab #: 97-U012057
Project: VLF 3 DEWATER WELL
Sample Desc: DW-20-45

Date Sampled: 10/28/97
Date Submitted: 10/29/97

Time Sampled: 13:30
Time Received: 16:02

CERTIFICATE OF ANALYSIS

PARAMETER	RESULT	MDL	DATE ANALYZED	METHOD	ANALYST
INORGANIC PARAMETERS					
Nitrite, Nitrogen, mg/L	4.9	0.5	10/31/97 10:45	EPA 354.1	TM
Nitrate/Nitrite-Nitrogen, mg/L	305	80	11/ 5/97	EPA 353.1	LH
pH, units	7.10	0.05	10/29/97 17:00	EPA 150.1	LS
Phosphorus, Total, mg/L	0.56	0.05	11/ 6/97 9:00	SM 4500-P	TM
Sulfate, mg/L	3,130	1000	11/ 5/97 10:30	EPA 375.4	TM
Total Dissolved Solids, mg/L	8,270	10	11/ 4/97 15:00	EPA 160.1	LS
Total Suspended Solids, mg/L	361	1	10/29/97 17:00	EPA 160.2	LS
Turbidity, NTU	157	0.05	10/29/97 17:00	EPA 180.1	LS
Aluminum (T), as Al, mg/L	2.66	0.03	11/ 5/97 10:22	EPA 200.7	LH
Aluminum (D), as Al, mg/L	< 0.03	0.03	11/ 3/97 10:48	EPA 200.7	LH
Arsenic (T), as As, mg/L	1.20	0.06	11/ 3/97 10:49	EPA 200.7	LH
Arsenic (D), as As, mg/L	0.70	0.06	11/ 3/97 10:49	EPA 200.7	LH
Barium (T), as Ba, mg/L	1.61	0.005	11/ 5/97 10:22	EPA 200.7	LH
Barium (D), as Ba, mg/L	0.009	0.005	11/ 3/97 10:48	EPA 200.7	LH
Boron (T), as B, mg/L	0.09	0.05	11/ 5/97 10:22	EPA 200.7	LH
Calcium (T), as Ca, mg/L	467	0.1	11/ 5/97 10:22	EPA 200.7	LH
Chromium(T), as Cr, mg/L	0.012	0.005	11/ 5/97 10:22	EPA 200.7	LH
Chromium (D), as Cr, mg/L	< 0.005	0.005	11/ 3/97 10:48	EPA 200.7	LH
Copper (T), as Cu, mg/L	0.01	0.01	11/ 5/97 10:22	EPA 200.7	LH
Copper (D), as Cu, mg/L	< 0.01	0.01	11/ 3/97 10:48	EPA 200.7	LH

Approved By: _____

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6100 SOUTH STRATLER
SALT LAKE CITY UTAH 84107 6905
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Tooele, UT 84074-4447

Group #: 19275
Lab #: 97-U012057
Project: VLF 3 DEWATER WELL
Sample Desc: MW-20-45

Date Sampled: 10/28/97
Date Submitted: 10/29/97

Time Sampled: 13:30
Time Received: 16:02

CERTIFICATE OF ANALYSIS

PARAMETER	RESULT	MDL	DATE ANALYZED	METHOD	ANALYST
INORGANIC PARAMETERS					
Gold (T), as Au, mg/L	0.04	0.02	11/ 6/97 12:00	EPA 200.7	LH
Gold (D), as Au, mg/L	0.04	0.02	11/ 6/97 12:00	EPA 200.7	LH
Iron (T), as Fe, mg/L	7.36	0.02	11/ 5/97 10:22	EPA 200.7	LH
Iron (D), as Fe, mg/L	0.74	0.02	11/ 3/97 10:48	EPA 200.7	LH
Magnesium (T), as Mg, mg/L	73.2	0.1	11/ 5/97 10:22	EPA 200.7	LH
Magnesium (D), as Mg, mg/L	72.9	0.1	11/ 3/97 10:48	EPA 200.7	LH
Manganese (T), as Mn, mg/L	1.64	0.01	11/ 5/97 10:22	EPA 200.7	LH
Manganese (D), as Mn, mg/L	1.66	0.01	11/ 3/97 10:48	EPA 200.7	LH
Nickel (T), as Ni, mg/L	0.04	0.01	11/ 5/97 10:22	EPA 200.7	LH
Nickel (D), as Ni, mg/L	0.03	0.01	11/ 3/97 10:48	EPA 200.7	LH
Potassium (T), as K, mg/L	20.2	0.1	11/ 5/97 10:22	EPA 200.7	LH
Selenium (T), as Se, mg/L	0.16	0.08	11/ 3/97 10:49	EPA 200.7	LH
Selenium (D), as Se, mg/L	0.20	0.08	11/ 3/97 10:49	EPA 200.7	LH
Silicon Dioxide, mg/L	28.1	0.2	11/ 5/97 10:22	EPA 200.7	LH
Silver (T), as Ag, mg/L	< 0.005	0.005	11/ 5/97 10:22	EPA 200.7	LH
Silver (D), as Ag, mg/L	< 0.005	0.005	11/ 3/97 10:48	EPA 200.7	LH
Sodium (T), as Na, mg/L	1,720	1	11/ 5/97 10:22	EPA 200.7	LH
Thallium (T), as Tl, mg/L	0.3	0.15	11/ 3/97 10:49	EPA 200.7	LH
Thallium (D), as Tl, mg/L	0.2	0.15	11/ 3/97 10:49	EPA 200.7	LH
Zinc (T), as Zn, mg/L	0.02	0.01	11/ 5/97 10:22	EPA 200.7	LH

Approved By: _____

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6100 SOUTH STRATLER
SALT LAKE CITY UTAH 84107 6905
801 262 7299 PHONE
801 262 7378 FAX

CHEMTECH-FORD ANALYTICAL LABORATORIES

Date: 11/19/97

To: Barrick Mercur Gold Mine
attn. Dave Beatty
P.O. Box 838
Tooele, UT 84074-4447

Group #: 19275
Lab #: 97-U012057
Project: VLF 3 DEWATER WELL
Sample Desc: MW-20-45

Date Sampled: 10/28/97
Date Submitted: 10/29/97

Time Sampled: 13:30
Time Received: 16:02

CERTIFICATE OF ANALYSIS

PARAMETER	RESULT	MDL	DATE ANALYZED	METHOD	ANALYST
INORGANIC PARAMETERS					
Zinc (D), as Zn, mg/L	< 0.01	0.01	11/ 3/97 10:48	EPA 200.7	LH
Cadmium (T), as Cd, mg/L	< 0.001	0.001	11/ 6/97 10:56	EPA 200.9	EG
Cadmium, (D) as Cd, mg/L	< 0.001	0.001	11/ 6/97 10:56	EPA 200.9	EG
Lead (T), as Pb, mg/L	0.013	0.005	11/ 6/97 13:57	EPA 200.9	EG
Lead,(D) as Pb, mg/L	0.012	0.005	11/ 6/97 13:57	EPA 200.9	EG
Cation, meq/L	104.7				
Anion, meq/L	87.40				
% Difference,	-8.98				
Receiving Temperature, C	0.1		10/29/97 16:02		RCG

NOTE: Sample submitted on ice.
Sample submitted past holding time for Cr(Hex).
Missed hold time for NO2 due to late sample submission
Suspended matter in metals container thus having an affect on cation/anion balance

Approved By: _____

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CHEMTECH-FORD ANALYTICAL LABORATORIES

Date: 11/19/97

To: Barrick Mercur Gold Mine
attn. Dave Beatty
P.O. Box 838
Tooele, UT 84074-4447

Group #: 19275
Lab #: 97-U012058
Project: VLF 3 DEWATER WELL
Sample Desc: [redacted]W-20-90

Date Sampled: 10/28/97
Date Submitted: 10/29/97

Time Sampled: 15:10
Time Received: 16:02

CERTIFICATE OF ANALYSIS

PARAMETER	RESULT	MDL	DATE ANALYZED	METHOD	ANALYST
INORGANIC PARAMETERS					
Bicarbonate as HCO3, mg/L	351	1	11/ 3/97 14:00	SM 2320B	TM
Carbonate as CO3, mg/L	< 1	1	11/ 3/97 14:00	SM 2320B	TM
Hydroxide as OH, mg/L	< 1	1	11/ 3/97 14:00	SM 2320B	TM
Alkalinity, Total (CaCO3), mg/L	288	1	11/ 3/97 14:00	SM 2320B	TM
Ammonia-Nitrogen, mg/L	8.4	0.2	11/ 7/97 9:00	SM 4500G/F	TM
Chloride (D), mg/L	410	1	11/ 3/97 12:30	EPA 325.3	TM
Chromium, Hexavalent, mg/L	< 0.02	0.02	10/31/97 10:45	SM18,3500D	TM
Conductance, Specific, umhos/cm	9,472	0.1	11/ 5/97 9:00	EPA 120.1	KRF
Cyanide, Amenable to Cl2, mg/L	3.61	0.002	11/13/97 16:00	ASTM D2036	TPH
Cyanide, Free, mg/L	0.31	0.01	11/13/97 16:00	ASTM D2036	TPH
Cyanide (T), mg/L	3.7	0.1	11/11/97 16:00	ASTM D2036	TPH
Cyanide, WAD, mg/L	0.082	0.002	11/11/97 16:00	ASTM D2036	TPH
Fluoride, mg/L	0.6	0.1	10/31/97 12:00	EPA 340.2	EG
Hardness, EDTA Titration, mg/L	1,680	50	11/ 4/97 8:00	EPA 130.2	TM
Hardness Index: Very Hard Water					
Hardness, (n-carb), mg/l	1,329	50		CAL	
Hardness, (calc), mg/L	1,530	50		CAL	
Mercury (T), as Hg, mg/L	0.0052	0.0002	11/ 3/97 13:29	EPA 245.1	EG
Mercury, as Hg (D), mg/L	0.0031	0.0002	11/ 3/97 13:29	EPA 245.1	EG
Nitrate, Nitrogen, mg/L	281	80	11/ 5/97	EPA 353.1	LH

Approved By: 

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Date: 11/19/97

To: Barrick Mercur Gold Mine
attn. Dave Beatty
P.O. Box 838
Tooele, UT 84074-4447

Group #: 19275
Lab #: 97-U012058
Project: VLF 3 DEWATER WELL
Sample Desc: DW-20-90

Date Sampled: 10/28/97
Date Submitted: 10/29/97

Time Sampled: 15:10
Time Received: 16:02

CERTIFICATE OF ANALYSIS

PARAMETER	RESULT	MDL	DATE ANALYZED	METHOD	ANALYST
INORGANIC PARAMETERS					
Nitrite, Nitrogen, mg/L	5.0	0.5	10/31/97 10:45	EPA 354.1	TM
Nitrate/Nitrite-Nitrogen, mg/L	286	80	11/ 5/97	EPA 353.1	LH
pH, units	7.10	0.05	10/29/97 17:00	EPA 150.1	LS
Phosphorus, Total, mg/L	0.56	0.05	11/ 6/97 9:00	SM 4500-P	TM
Sulfate, mg/L	3,190	1000	11/ 5/97 10:30	EPA 375.4	TM
Total Dissolved Solids, mg/L	8,310	10	11/ 4/97 15:00	EPA 160.1	LS
Total Suspended Solids, mg/L	322	1	10/29/97 17:00	EPA 160.2	LS
Turbidity, NTU	142	0.05	10/29/97 17:00	EPA 180.1	LS
Aluminum (T), as Al, mg/L	1.81	0.03	11/ 5/97 10:22	EPA 200.7	LH
Aluminum (D), as Al, mg/L	< 0.03	0.03	11/ 3/97 10:48	EPA 200.7	LH
Arsenic (T), as As, mg/L	1.28	0.06	11/ 3/97 10:49	EPA 200.7	LH
Arsenic (D), as As, mg/L	0.81	0.06	11/ 3/97 10:49	EPA 200.7	LH
Barium (T), as Ba, mg/L	1.56	0.005	11/ 5/97 10:22	EPA 200.7	LH
Barium (D), as Ba, mg/L	0.010	0.005	11/ 3/97 10:48	EPA 200.7	LH
Boron (T), as B, mg/L	0.10	0.05	11/ 5/97 10:22	EPA 200.7	LH
Calcium (T), as Ca, mg/L	488	0.1	11/ 5/97 10:22	EPA 200.7	LH
Chromium(T), as Cr, mg/L	0.010	0.005	11/ 5/97 10:22	EPA 200.7	LH
Chromium (D), as Cr, mg/L	< 0.005	0.005	11/ 3/97 10:48	EPA 200.7	LH
Copper (T), as Cu, mg/L	0.01	0.01	11/ 5/97 10:22	EPA 200.7	LH
Copper (D), as Cu, mg/L	< 0.01	0.01	11/ 3/97 10:48	EPA 200.7	LH

Approved By: _____

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CHEMTECH-FORD ANALYTICAL LABORATORIES

Date: 11/19/97

To: Barrick Mercur Gold Mine
attn. Dave Beatty
P.O. Box 838
Tooele, UT 84074-4447

Group #: 19275
Lab #: 97-U012058
Project: VLF 3 DEWATER WELL
Sample Desc: MW-20-90

Date Sampled: 10/28/97
Date Submitted: 10/29/97

Time Sampled: 15:10
Time Received: 16:02

CERTIFICATE OF ANALYSIS

PARAMETER	RESULT	MDL	DATE ANALYZED	METHOD	ANALYST
INORGANIC PARAMETERS					
Gold (T), as Au, mg/L	0.04	0.02	11/ 6/97 12:00	EPA 200.7	LH
Gold (D), as Au, mg/L	0.04	0.02	11/ 6/97 12:00	EPA 200.7	LH
Iron (T), as Fe, mg/L	5.05	0.02	11/ 5/97 10:22	EPA 200.7	LH
Iron (D), as Fe, mg/L	0.72	0.02	11/ 3/97 10:48	EPA 200.7	LH
Magnesium (T), as Mg, mg/L	76.7	0.1	11/ 5/97 10:22	EPA 200.7	LH
Magnesium (D), as Mg, mg/L	73.2	0.1	11/ 3/97 10:48	EPA 200.7	LH
Manganese (T), as Mn, mg/L	1.70	0.01	11/ 5/97 10:22	EPA 200.7	LH
Manganese (D), as Mn, mg/L	1.67	0.01	11/ 3/97 10:48	EPA 200.7	LH
Nickel (T), as Ni, mg/L	0.04	0.01	11/ 5/97 10:22	EPA 200.7	LH
Nickel (D), as Ni, mg/L	0.04	0.01	11/ 3/97 10:48	EPA 200.7	LH
Potassium (T), as K, mg/L	21.0	0.1	11/ 5/97 10:22	EPA 200.7	LH
Selenium (T), as Se, mg/L	0.18	0.08	11/ 3/97 10:49	EPA 200.7	LH
Selenium (D), as Se, mg/L	0.18	0.08	11/ 3/97 10:49	EPA 200.7	LH
Silicon Dioxide, mg/L	25.2	0.2	11/ 5/97 10:22	EPA 200.7	LH
Silver (T), as Ag, mg/L	< 0.005	0.005	11/ 5/97 10:22	EPA 200.7	LH
Silver (D), as Ag, mg/L	< 0.005	0.005	11/ 3/97 10:48	EPA 200.7	LH
Sodium (T), as Na, mg/L	1,750	1	11/ 5/97 10:22	EPA 200.7	LH
Thallium (T), as Tl, mg/L	0.3	0.15	11/ 3/97 10:49	EPA 200.7	LH
Thallium (D), as Tl, mg/L	0.2	0.15	11/ 3/97 10:49	EPA 200.7	LH
Zinc (T), as Zn, mg/L	0.02	0.01	11/ 5/97 10:22	EPA 200.7	LH

Approved By: _____

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Date: 11/19/97

To: Barrick Mercur Gold Mine
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Group #: 19275
Lab #: 97-U012058
Project: VLF 3 DEWATER WELL
Sample Desc: MW-20-90

Date Sampled: 10/28/97 Time Sampled: 15:10
Date Submitted: 10/29/97 Time Received: 16:02

CERTIFICATE OF ANALYSIS

PARAMETER	RESULT	MDL	DATE ANALYZED	METHOD	ANALYST
INORGANIC PARAMETERS					
Zinc (D), as Zn, mg/L	< 0.01	0.01	11/ 3/97 10:48	EPA 200.7	LH
Cadmium (T), as Cd, mg/L	< 0.001	0.001	11/ 6/97 10:56	EPA 200.9	EG
Cadmium, (D) as Cd, mg/L	< 0.001	0.001	11/ 6/97 10:56	EPA 200.9	EG
Lead (T), as Pb, mg/L	0.013	0.005	11/ 6/97 13:57	EPA 200.9	EG
Lead,(D) as Pb, mg/L	0.009	0.005	11/ 6/97 13:57	EPA 200.9	EG
Cation, meq/L	107.1				
Anion, meq/L	88.49				
% Difference,	-9.50				
Receiving Temperature, C	0.1		10/29/97 16:02		RCG

NOTE: Sample submitted on ice.
Sample submitted past holding time for Cr(Hex).
Missed hold time for NO2 due to late sample submission
Suspended matter in metals container thus having an affect on cation/anion balance

Approved By: _____

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ATTACHMENT B
WELL TEST METHODS, DATA AND ANALYSIS

B-1.0 INTRODUCTION

A short-term specific capacity pumping test was conducted in well DW-20 on October 28, 1997 to estimate the specific capacity of the well. The average pumping rate and total drawdown measured during the test and the specific capacity, estimated from the test are estimated from measurements taken during the test. This attachment describes field methods used to conduct the test, presents the data obtained from the test, and summarizes the analytical methods used to estimate specific capacity.

B-2.0 FIELD METHODS AND DATA

The short-term specific capacity pumping test of well DW-20 was conducted using a temporary 4-inch submersible pump. On the day of the pumping test the pump was turned on from approximately 11:36 AM to 13:07 PM to adjust the pumping rate. Pumping rate measurements were made using a calibrated bucket and stop watch. The water level was allowed to recover for about 7 minutes after the pump was turned off before capacity test was started. The pumping test was conducted from 13:14 to 16:27 PM, a total pumping period of 193 minutes. Recovery measurements were obtained, but were not useful data because the water from the pumping column drained into the well.

Water level measurements were made during the test using an electric water level meter. Depth to water measurements, the time of each measurement, and the drawdown, recovery, and residual drawdown calculated were recorded during the test.

B-3.0 EVALUATION OF DATA

The recorded pumping rates ranged from 13.5 to 22.5 gpm. For most of the test the pumping rate was 20 gpm. A maximum drawdown of 2.4 feet was observed after about 3 minutes of pumping. The water level observed during the rest of the test rose up to about a foot or more, despite the increases in pumping rates during the test. The reason for the rise in water levels is unclear, because it does not appear to coincide with the snowmelt

that was occurring during the test. A possible explanation for the rise in water levels is a decrease in pumping rate that occurred in the first few minutes of the test caused by the head loss associated with lifting water from the pumping water level to the ground surface. The first pumping rate measurement was made after approximately 3 minutes of pumping.

The water level rose to above the static water level during the recovery because the pump was not equipped with a check valve, which allowed water in the discharge pipe to flow back into the well.

Specific Capacity

According to Lohman (1972), specific capacity is equal to the pumping rate divided by the observed drawdown at a specified time during pumping. The drawdown observed at the end of the test (1.61 feet) was divided into the pumping rate measured at the end of the test (21 gpm) to obtain an estimated specific capacity of 13 gpm/foot for well DW-20.

REFERENCES CITED

Lohman, S.W., 1972, Ground-Water Hydraulics: U.S. Geological Survey Professional Paper 708, 70 p.